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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 (PA) levels are associated with better quality of life in people with head and neck cancer (HNC). 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 PA in this group. Therefore, we reviewed and mapped the available literature on factors that may influence PA in people with HNC.

Design We conducted a scoping review based on the framework of Arksey and O'Malley and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline extension for scoping reviews.

Data sources CINHAL, the Cochrane Library, EMBASE, PsycINFO, MEDLINE and Scopus were searched from inception to July 2023.

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

Data extraction and synthesis Data were extracted and synthesised 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 were charted descriptively, and qualitative data were analysed and summarised using a basic content analysis approach.

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

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 PA included perceived or experienced mental and health-related benefits. Consensus among patients, healthcare professionals and researchers highlighted the necessity for enhanced information and education, emphasising individualised approaches to promote PA throughout the cancer continuum.

Conclusions Numerous factors affect PA in individuals with HNC. 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 PA promotion into the care pathway.

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 physical activity (PA) modalities included everyday activities and targeted PA 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 HNC 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 with 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 organised, characterised 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 to 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*[20] showed that patients with HNC undergoing chemoradiotherapy 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 7 weeks followed by a home-based exercise programme for 4 weeks. An observational longitudinal study by Huang *et al*[22] 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.[23 24] Already prior to diagnosis, this group appears to have low activity levels.[23] Barriers to 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 programmes 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 questions by exploring the existing knowledge and prior research on factors that influence PA in patients with HNC.[27] Our methods were based on Arksey and O'Malley's framework,[28] best practice guidance by Peters *et al*[29] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline extension for scoping reviews.[30]

Search strategy and eligibility criteria

We adopted a broad search strategy for three concepts: (1) HNC, (2) influencing factors including barriers, facilitators, beliefs, perceptions and views and (3) PA, exercise or physical training. A medical librarian 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 online supplemental 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 5 July 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.[31] The screening of titles and abstracts was conducted independently by 2 reviewers (MS and a research assistent), 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 and 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 were 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[32] by deductively allocating concepts or characteristics into categories.[33] 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 programme 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 (figure 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.

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 USA, followed by Canada, the UK and the Netherlands (four each). Germany and Sweden each contributed one study. There were 11 quantitative studies,[34–44] six qualitative studies[45–50] and two mixed methods studies.[51 52] The majority (n=13) had a cross-sectional design, reporting outcomes derived from

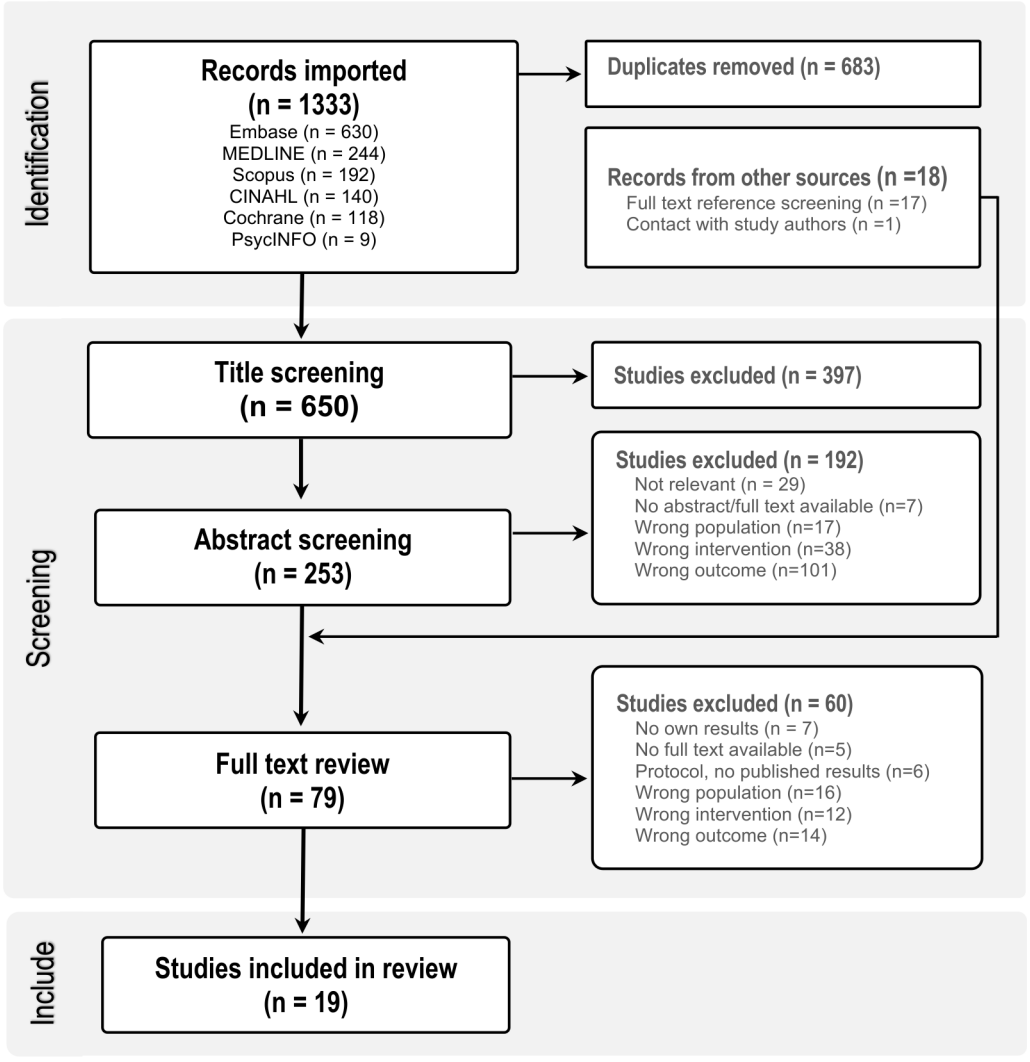

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart on study inclusion.

surveys or standardised 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 utilising focus group interviews (see table 1). For more details on the included studies, see online supplemental S2.

Description of study participants

Patients before, during and shortly after medical treatment for HNC were included,[35 38 43 47 50 52] as well as individuals within the first year after treatment, or during long-term care.[34 36 37 39–42 44–46 48 49 51] 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 PA

Seven publications analysed associations between a variety of factors and PA levels, interest and intention for PA.[34 35 37 39–41 52] 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,[34 39] educational level,[41] marital status,[34] alcohol consumption,[35] having worries about harm,[52] being committed to or motivated for PA,[52] setting goals or perceiving barriers, enjoying PA or being self-efficient.[35 37] Health-related factors included cancer stage or type, sleep quality,[34] having comorbidities,[34 35 39] weight loss[39] or having a feeding tube.[34] Intention and interest for PA were influenced by the person's age, health condition[40] and attitude towards PA[39 40] or exercise history[39] The type and direction of the associations are presented in table 2.

Barriers to and facilitators for PA

Of the 19 studies included in this analysis, 13 reported barriers to PA,[37 38 40–44 46 48–52] while seven reported factors that facilitate engagement in PA.[40 45 48–52]

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 41 44 48–52] Pain, both in general,[40 41 48 50 52] and specifically in the head, neck and shoulder region,[44 49] as well as eating and feeding difficulties,[37 40 41 49–51] hindered PA. Environmental barriers to PA were primarily related to work and family responsibilities.[42 43 49–51] Personal barriers to PA were mainly due to lack of time,[42 43 49–51] motivation, interest and intention.[37 42 51 52] Some participants mentioned laziness,[48 49] and some feared worsening their condition.[41 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,[47–50 52] and experiencing or perceiving general health benefits.[40 48–50] PA was also enhanced by a sense of power and control and the positive feelings that resulted from PA.[39 45 50 52] Emotional and practical support from an individual's network, including partners and family members, was a major social factor that facilitated PA.[45 48 52]

Patients' beliefs, views and perceptions on PA

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 52] providing them with a sense of personal empowerment.[45] 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.[51] 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.[46]

Participants suggested that a tailored programme 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 minimise risk of injury and to enhance adherence and enjoyment.[35] Participants also emphasised that surgeons should support and encourage PA.[47 49]

Healthcare professionals' and researchers' views and recommendations on PA in people with HNC

With the exception of three studies,[37 38 44] all of the included publications stated expert views and recommendations on PA promotion. From these 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.[34 35 40 41 46 48–50 52] Tailored and individualised approaches were suggested to help people with a HNC diagnosis to increase their PA levels.[40 43 47 49 51] 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.[41 43 47–49]

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.[41 47 49] Individuals diagnosed with HNC tend to overestimate their activity level and may require special guidance and referrals to exercise specialists to help them prioritise PA and change their behaviour.[48 52] PA interventions should be integrated into the HNC care

Table 1 Overview of included studies

Study—country	Aim of study	Study type/design	Type of PA	Participants
Björklund *et al*[45]—SE	To explore health promotion from the perspective of individuals with HNC.	Semistructured individual interviews	Everyday PA	N=8 patients; 1–9 months after diagnosis
Duffy *et al*[34]—USA	To analyse five health behaviours (smoking, problem drinking, nutrition, PA and sleep) in the first year after diagnosis.	Prospective, cohort study with online survey and chart review	Everyday PA	N=283 patients; within first year of diagnosis
Rogers *et al*[35]—USA	To determine the most frequent and important PA barriers reported by patients with HNC.	Cross-sectional study with questionnaires and chart review	Everyday PA	N=59 patients; 86% on treatment, 14% off treatment
Rogers *et al*[36]—USA	To explore exercise counselling 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 *et al*[37]—USA	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=101 patients; mean time since diagnosis: 26.4 months (SD±43.9)
Zhao *et al*[38]—USA	To assess the benefits of a resistance and walking exercise intervention during and shortly after chemoradiotherapy; 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 *et al*[46]—CA	To explore needs and experiences of patients with HNC regarding behavioural change (tobacco use, alcohol misuse, diet, exercise and ultraviolet protection), as well as the barriers and facilitators to change.	Focus group interviews	Everyday PA	N=29 patients; mean time since diagnosis: 18.7 months (SD±12.3)
Jackson *et al*[51]—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; mean time since diagnosis: 27,9 months (SD±6.5)
Buffart *et al*[39]—NL	To identify social-cognitive correlates of PA using the theory of planned behaviour model in addition to demographic, clinical and lifestyle-related correlates.	Cross-sectional study with survey	Everyday PA	N=416 patients (combination of two studies); median time since treatment: 54 months (IQR: 33–120)
Midgley *et al*[40]—UK	To establish exercise preferences, barriers and perceived benefits among HNC survivors and to investigate the level of interest in participating in an exercise programme.	Cross-sectional study with questionnaire pack	Everyday PA	N=437 patients; median time since diagnosis: 43 months (IQR: 30–58)

Continued

Table 1 Continued

Study—country	Aim of study	Study type/design	Type of PA	Participants
Rogers *et al*[41]—UK	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 programme.	Cross-sectional study with questionnaire pack	Everyday PA	Same sample as Midgley *et al*[40]
Felser *et al*[42]—DE	To evaluate the feasibility and impact of a low-intensity to medium-intensity exercise intervention on physical function and quality of life.	Feasibility study	Targeted PA	N=12 patients; 67% more >5 years, 33% <5 years since diagnosis
Daun *et al*[47]—CA	To understand patient and healthcare professional perspectives on the role of multiphasic exercise prehabilitation.	Semistructured interviews	Targeted PA	N=20 interview participants; (10 patients: mean 10.5 days (SD±8.6) to surgery and 10 HCPs)
Hanika *et al*[48]—UK	To explore health-related behavioural 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 *et al*[43]—NL	To assess the feasibility of a tailored exercise programme for patients with HNC during chemoradiotherapy.	Feasibility study	Targeted PA	N=34 patients with locally advanced HNC; during treatment
Rogers *et al*[49]—UK	To get insight into how and why patients with HNC would be interested in participating in an exercise programme.	Semistructured telephone interviews	Targeted PA	N=22 patients; subsample of Midgley *et al*[40]
Sealy *et al*[52]—NL	To explore HNC survivors' views on PA and to analyse self-perceived PA levels compared to objectively measured PA.	Mixed methods study	Everyday PA	N=9 patients before surgery with curative intent
Ntoukas *et al*[44]—CA	To test the feasibility and safety of a heavy lifting strength training programme.	Feasibility study	Targeted PA	N=9 patients; time since surgery: <5 years: 3 (33%), ≥5 years: 6 (67%)
Kok *et al*[50]—NL	To explore preferences and expectations of an exercise intervention during chemoradiotherapy and to identify factors influencing adherence, retention and compliance.	Semistructured interviews (pre and post intervention)	Targeted PA	N=14 patients; subsample of Kok *et al*[43]

CA, Canada; DE, Germany; HCP, healthcare professionals; HNC, head and neck cancer; NL, the Netherlands; PA, physical activity; SE, Sweden; UK, United Kingdom; USA, United States of America.

pathway as usual care[40 47 50] and should be promoted by all members of the healthcare team.[42 47 49]

The type and mode of delivery of PA interventions or programmes should be tailored to an individual's abilities, preferences and goals.[40 43 47 49 50] Furthermore, PA programmes should be flexible and take place at locations convenient for the patient.[50 51]

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,

Table 2 Associations between different factors and physical activity

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.[52]
Associated with higher PA level	Younger age, no unintentional weight loss, no comorbidities[39]; having a higher education level[41]; being committed to or motivated for PA[52]; self-efficacy and goal setting.[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.[39]
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[40]

PA, physical activity.

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 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 patients with HNC.[23]

Barriers to and facilitators for PA

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 comorbidities that hinder PA. Gildea *et al*[53] 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, can be alleviated through exercise and PA.[54] Sharp *et al*[55] demonstrated that almost one-third of patients with HNC 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[56 57] 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 barriers. According to a systematic review by van den Beuken *et al*,[58] patients with HNC had a higher prevalence of pain compared with those with other cancer types. Patients with oral cancer were found to be particularly susceptible to pain, with almost 70% affected.[59] Swallowing, eating and feeding difficulties are also highly prevalent and specific to HNC, placing a significant burden on affected individuals,[60] and feeding tubes may be required.[61] 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] and seems to be most prominent in the phase after treatment.[53]

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.[53 62] Therefore, interventions promoting PA should actively involve and encourage family members or other individuals from patients' networks to support PA. Osazuwa-Peters *et al*[63] 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.[64]

Patients' beliefs, views and perceptions on 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

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]	3/485	Feeling mentally/physically better and more normal[47 48 51 53]	4/63
	Lack of confidence: fear of injury and making the condition worse[45 48]	2/457	Positive feelings (contentment, power and control, confidence, self-esteem)[35 51 53]	3/31
	Not feeling comfortable: pressured by coaching approach [53] ; intimidation by group format[42]	2/74	Enjoyment of being outdoors[48]	1/20
	Attitude			
	Lack of time[42 46 49 50 53]	5/142	Returning to normal life and better function as motivators[40 48] ;	2/31
	Lack of motivation/ interest/enjoyment[39 42 46]	3/173	Not feeling anxious and having experienced the benefits (after intervention)[42]	1/60
	Not having a preference concerning the source of counselling and exercise variability[38]	1/90	Making you feel better, improved attitude[50]	1/22
	Overestimation of own PA levels[48]	1/20	Using terms “movement” or “physical activity” rather than “exercise”[47]	1/20
	Lack of intention, no interest or aversion towards more PA[51]	1/9	After exercise participation decreased barrier: “lack of interest” and “exercise is boring”[40]	1/11
	Behaviour			
	Laziness[48 50]	2/42	Enjoyment by social environment and accountability to instructors and group[42]	1/60
	Missing structure and accountability after intervention[42]	1/60	Structured programme[42]	1/60
	Lacking prior experiences/sporty attitude, loss of self-control[53]	1/14	Prior experiences/sporty attitude[53]	1/14
	Being sedentary, but confident to have adequate PA level[51]	1/9	Most important motivator to continue exercise: beneficial, motivated, controllability[52]	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]	5/73
			Group setting and instructors created a positive atmosphere and a possibility to exchange and discuss experiences[42 46]	2/72
			Social aspect of PA[48 50]	2/42
			Hobbies[48]	1/20
			Commitment to study programme,[53]	1/14
			Personal coaching and empowerment with clear instruction, personalised intervention[53]	1/14

Continued

Table 3 Continued

	PA barriers*	f/n*	PA facilitators*	f/n*
Environmental factors	Work and family responsibilities[38 42 46 48 51]	5/191	External incentive, chemo dog[53]	1/14
	Distance to training facility, lack of transportation or too time consuming[45 51 53]	3/460	Structure of daily life activities, home-based, simplicity of the intervention[53]	1/14
	Weather condition[38 48 51]	3/119		
	No or little advice on PA[44 51]	2/446		
	A hostile exercise environment[38 48]	2/110		
	Financial problems/constraints[48 51]	2/29		
	HCPs approach and focus on prevention rather than on resuming function[44]	1/437		
	Content of exercise programme unclear[53]	1/14		
Health- or treatment related factors	Fatigue or loss of energy[42 44 45 48 50–53]	8/1008	Experienced or perceived general health benefits[44 48 50 53]	4/493
	General pain ,[44 45 48 51 53]or pain specified to head, neck or shoulder[50 52]	7/948	Building up strength and fitness[44 48 50]	3/479
	Other physical complaints[42 49 50 52 53]	5/762	Reducing risk of disease[44]	1/437
	Problems with eating/feeding[38 42 45 50 53]	5/623	Increased energy levels, less fatigue[42]	1/60
	Dry mouth or throat[38 44 45 50]	4/1105	Psychological benefits[48]	1/20
	General treatment toxicity[40 42 49 53]	4/119		
	Pre-existing health problems, comorbidities[45 50 51]	3/468		
	General weakness[44 48]	2/457		
	Shoulder weakness,[44 45]	2/874		
	Difficulties with breathing[44 45] ; experience of choking feeling during exercise[50]	3/500		
	Weight loss[53]	1/14		
	Hospital admittance[53]	1/14		

*f: frequency=number of publications in which this factor is stated; n: number of participants within these publications
HCPs, healthcare professionals; PA, physical activity.

studies indicating that PA is linked to an improved health status and an improved sense of control and satisfaction for patients with HNC, as well as those with other cancer types.[17 25 26]

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 52] 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*,[65] 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.[46 48]

Healthcare professionals' and researchers' views and recommendations on PA in people with HNC

Tailored interventions or PA programmes 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[66] in the USA and the guidelines of the European Society of Medical Oncology (ESMO)[67] have not yet incorporated this recommendation. Conversely, the American Cancer Society's HNC survivor guidelines[68] proposes PA for

Table 4 Expert views and recommendations on PA in people with head and neck cancer*

Addressing symptoms and barriers	► Address PA barriers and give patients advice on how to overcome them.[40 41 48 49] ► Physical[34 46 52] and psychological[50] impairments (eg, distress, anxiety, depression) need to be adequately addressed. ► 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.[48] ► Referrals to specialists should be made for individuals with more needs/worries about exercise.[52]
Providing information and education	► Give education and training for HCP and patients to be aware of benefits of exercise.[40 47 49] ► Patient education about symptom management should be offered to enhance self-efficacy and PA[35]; 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.[43] ► Information on exercise should ideally be given soon after time of diagnosis.[40] ► 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.[46 48] ► Assistance by medical professionals or exercise specialist should be given to find a suitable type of PA.[36 46] ► Supporting the empowerment process is important.[39] ► Some patients will need professional guidance to help prioritise PA.[52] ► Patient education about exercise benefits should be given to increase confidence, competence, uptake and adherence.[49] ► 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.[52] ► Provide access to HCPs at the end of treatment to guide lifestyle decisions.[48] ► Potential intention-behaviour gap needs to be considered.[39] ► Intention might need to be targeted; pedometers or accelerometers might improve awareness of actual PA levels.[52] ► The health behaviour history needs to be included in the survivorship care plan.[46]
Support provided within the healthcare system	► Exercise and PA interventions should be integrated within the oncological care pathway as usual care.[40 47 50] ► There should be a culture shift towards more PA; necessary prescriptions should be provided.[47 48] ► Surgeons should advise and encourage exercise.[47 49] ► All members of the healthcare team should motivate and facilitate exercise as part of recovery.[49] ► Exercise specialists should be involved in the care pathway.[47] ► Exercise and PA interventions should start as early as possible.[50]
Suggestions about PA intervention delivery	Type of intervention: ► Programmes and interventions should be tailored to each patient's abilities and preferences.[40 43 47 49] ► Collaborative, flexible, culturally sensitive and individualised approaches are needed.[49] ► Exercise interventions should be tailored and personalised with regard to goal setting, training type, intensity, setting and timing and should be incorporated in ADLs.[50] ► A flexible training programme should be offered with check-in policy after several missed classes at the end stage of treatment.[51] ► 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 chemoradiotherapy.[50] ► It is assumed that attendance rate and effects are lower for unsupervised training interventions.[42] ► Patients should be monitored before and during exercise.[43] ► 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.[43] ► Resources need to be built to support exercise into cancer survivorship and in community-based settings.[47] ► Need for funding for exercise programmes (outside of study context).[47]

*All views and recommendations are extracted from the Discussion section of the publications with the exception of Daun *et al*[47] who used interviews with HCPs.
ADL, activities of daily living; HCPs, healthcare professionals; PA, physical activity.

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.[69 70]

Our review confirms that patients with HNC require customised programmes, consistent with the recommendations for PA promotion for patients affected by various cancer types.[17 18 26 53] 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*[71] 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 PA promotion within the care continuum of individuals with HNC.

1. Understanding how, when and by whom screening for relevant symptoms and barriers related to PA 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 PA in individuals with HNC.

Strengths and limitations

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.[25 26] 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. The results of this review are not generalisable 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.[28]

Conclusion

Personal, social, environmental and health-related factors have an influence on PA in patients with HNC. These factors encompass personal characteristics such as age and comorbidities, 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 personalised 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 acts as the guarantor and planned the study with the support of MB and MW. MS carried out the literature search and did the screening of all titles and abstracts with the help of a research assistent. MS, MB and RE did the screening of full texts and the literature review, MS drafted the manuscript. MB, RE and MW assisted with data interpretation and drafting the manuscript. All authors read and approved the final manuscript.

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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)

Schmocker M, *et al. BMJ Open* 2024; 14:e083852. doi: 10.1136/bmjopen-2023-083852

- 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	*not applicable*	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 to 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 years (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 = 0.41; p = 0.002) - symptom index (r = −0.36; p = 0.006) - alcohol use (r = 0.36; p = 0.007) - task self-efficacy (r = 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 (50%) - 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 prioroty, - 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	*not applicable*	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 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 behaviour (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), invaded 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	*not applicable*	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.	*not applicable*	- 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 chemoradiotherapy; 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.	*not applicable*	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 feels 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 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 feasibility 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	*not applicable*	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

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