An Overview on the Evidence of Physical Activity Interventions in the Health of Individuals with Head and Neck Cancer: Literature Systematic Review

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Um Panorama sobre as Evidências de Intervenções de Atividade Física na Saúde de Indivíduos com Câncer de Cabeça e Pescoço: Revisão Sistemática da Literatura

Un Panorama de las Evidencias de Intervenciones de Actividad Física en la Salud de Individuos con Cáncer de Cabeza y Cuello: Revisión Sistemática de la Literatura

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ABSTRACT

Introduction: Head and neck cancer is considered a global public health problem, which arises in aesthetically and functionally critical areas. The practice of physical exercise has been considered one of the significant and effective non-pharmacological strategies to minimize the physical and psychological consequences. **Objective:** To analyze the evidence of physical activity interventions in the physical and psychological health of individuals with head and neck cancer. **Method:** A systematic review was conducted blindly and independently, from March to May 2021, according to the PRISMA guidelines. The search was performed in the following databases: PubMed Central®; Cochrane Library; Web of Science, Scopus, ScienceDirect. **Results:** Of the 515 selected studies, 15 were included in this systematic review with a total of 670 participants aged between 18 and 76 years old. The studies included aerobic exercises, endurance, mobility, stretching, strengthening, and yoga. **Conclusion:** Evidence proves that physical activity interventions performed with individuals with head and neck cancer may be beneficial in the treatment and physical/psychological health of this population. This study may help new researches considering the detailed information described previously regarding the interventions applied, in addition to discussing the most used instruments with this public and indicating the modalities that are being safely performed. It is suggested that more randomized trials be conducted to obtain more concise results.

Key words: head and neck neoplasm/psychology; exercise therapy/psychology; exercise.

RESUMO

Introdução: O câncer de cabeça e pescoço é considerado um problema de saúde pública mundial, que surge em áreas cosmeticamente e funcionalmente críticas. A prática de exercício físico está sendo considerada uma das estratégias não farmacológicas significativas e eficazes a fim de minimizar as consequências físicas e psicológicas. **Objetivo:** Analisar as evidências de intervenções de atividade física na saúde física e psicológica de indivíduos com câncer de cabeça e pescoço. **Método:** Revisão sistemática de forma cega e independente, de março a maio de 2021, de acordo com as diretrizes PRISMA. A busca foi realizada nas seguintes bases de dados: PubMed Central®; Biblioteca Cochrane; *Web of Science*, *Scopus*, *ScienceDirect*. **Resultados:** Entre os 515 estudos selecionados, 15 foram incluídos nesta revisão sistemática com um total de 670 participantes com idade entre 18 e 76 anos. Os estudos incluíram exercícios aeróbicos, resistência, mobilidade, alongamento, fortalecimento e ioga. **Conclusão:** Evidências comprovam que intervenções de atividade física realizadas com indivíduos com câncer de cabeça e pescoço podem ser benéficas no tratamento e na saúde física/psicológica dessa população. Este estudo pode auxiliar em novas pesquisas considerando as informações detalhadas descritas anteriormente sobre as intervenções aplicadas, além de discutir os instrumentos mais utilizados com esse público e indicar as modalidades que estão sendo realizadas com segurança. Sugere-se a realização de mais ensaios randomizados para obter resultados mais concisos.

Palavras-chave: neoplasias de cabeça e pescoço/psicologia; terapia por exercício/psicologia; exercício físico.

RESUMEN

Introducción: El cáncer de cabeza y cuello es considerado un problema de salud pública a nivel mundial que se presenta en áreas estética y funcionalmente críticas. La práctica de ejercicio físico ha sido considerada una de las estrategias no farmacológicas significativas y eficaces para minimizar las consecuencias físicas y psíquicas. **Objetivo:** Analizar la evidencia de intervenciones de actividad física sobre la salud física y psicológica de individuos con cáncer de cabeza y cuello. **Método:** Revisión sistemática ciega e independiente de marzo a mayo de 2021, según las guías PRISMA. La búsqueda se realizó en las siguientes bases de datos: PubMed Central®; Biblioteca Cochrane; *Web of Science*, *Scopus, ScienceDirect*. **Resultados:** Entre los 515 estudios seleccionados, 15 fueron incluidos en esta revisión sistemática con un total de 670 participantes con edades entre 18 y 76 años. Los estudios incluyeron ejercicio aeróbico, resistencia, movilidad, estiramiento, fortalecimiento y yoga. **Conclusión:** La evidencia demuestra que las intervenciones de actividad física realizadas con individuos con cáncer de cabeza y cuello pueden ser beneficiosas en el tratamiento y la salud física/psicológica de esta población. Este estudio puede ayudar a futuras investigaciones considerando la información detallada descrita anteriormente sobre las intervenciones aplicadas, además de discutir los instrumentos más utilizados con esta audiencia e indicar las modalidades que se están realizando de forma segura. Se sugieren más ensayos aleatorios para obtener resultados más concisos.

Palabras clave: neoplasias de cabeza y cuello/psicología; terapia por ejercicio/psicología; ejercicio físico.

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INTRODUCTION

Head and neck cancer belongs to a group of malignant neoplasms of the upper aerodigestive tract and the face located in the regions of the oral cavity, paranasal sinuses, salivary glands, pharynx, larynx, and thyroid that appears in critical areas and may produce changes in highly visible and socially significant portions[1], often aggressive due to location and treatment[2]. As a consequence, survivors face specific physical, psychosocial problems, and symptoms related to the disease and its treatment such as oral dysfunction, shoulder mobility, facial lymphedema in addition to swallowing and speech problems that seriously compromise the health-related quality-of-life[3-5].

Guidelines recommend that cancer survivors practice regular physical activities, performing at least 150 to 300 minutes of moderate-intensity aerobic physical activity or at least 75 to 150 minutes of vigorous aerobic physical activity. Another option would be an equivalent combination of moderate and vigorous activity during the week for substantial health benefits[6]. As a complementary therapy, physical exercise is considered one of the significant non-pharmacological strategies in the treatment of the disease, acting directly in physical and psychological health[7], contributing positively to the physiological function of the individual, associated with the improvement of quality-of-life[4,5,8]. Therefore, it was verified in the literature that one of the first studies that addressed interventions involving physical exercises and physical activity directed to patients with head and neck cancer was a randomized clinical trial by McNeely et al.[9], who evaluated the effects of progressive resistance exercise training on shoulder dysfunction, followed by Lønbro et al.[10] who investigated the effect of progressive resistance training, followed by Samuel et al.[11] which sought to evaluate the effects of physical training on functional capacity and quality-of-life.

Since then, few intervention studies involving this population have been performed, although literature reveals the existence of benefits in the plans of early physical exercises, aside from being viable and safe interventions with these patients[12-14]. However, the effectiveness of physical activity interventions related to this population is still considered to be inadequately understood[13]. Thus, the objective of this systematic review was to analyze the evidence of physical activity interventions in the physical and psychological health of individuals with head and neck cancer.

METHOD

This systematic review follows the guidelines of the Preferred Reporting Items for Systematic Reviews – PRISMA[15], it was registered in PROSPERO (International Prospective Register of Systematic Reviews)[16] - CRD42021265414, and its guiding question formed by the PICOS acronym is: What is the evidence of physical activity and/or physical exercise and body practices interventions in the physical and psychological health of adult individuals during and after head and neck cancer treatment?

Electronic researches were performed using the descriptors referred to in Chart 1 on five databases: PubMed Central®*;* Cochrane Library; - main collection, Web of Science; Scopus and ScienceDirect. All titles and abstracts found in the electronic search were analyzed through the application Rayyan and manually by two reviewers blindly and independently, in the period from 03/23/2021 to 05/16/2021. Reference lists of all relevant articles were examined to identify other eligible studies. The terms 'physical activity' and 'exercise' were used as a search strategy, with the intention of expanding the location of the greatest possible number of studies.

Chart 1. Complete search strategy in electronic databases, 2021

Terms	Descriptors
#1 Cancer	Head and neck cancer
#2 Intervention	Physical activity OR Physical exercise OR Body practices
#3 Study	Randomized clinical trial
Combination	#1 AND #2 OR #3 AND

The researchers members of the Leisure and Physical Activity Research Laboratory - LAPLAF/CNPq, performed the searches according to the eligibility criteria. The discrepancies were solved by a third author.

The eligibility criteria of the studies were defined according to the PICOS acronym considering the population, intervention, comparison, and study design (Chart 2). The eligible studies for this review were: a) randomized clinical trials; b) performed in adults (18 years); c) of both sexes; d) in treatment and post-treatment of head and neck cancer; e) published in English, Spanish and Portuguese in the last 10 years; f) studies that should investigate interventions with physical activities and/or physical exercise in the treatment of head and neck cancer, with summary and full text available during the period of 03/23/2021 to 05/16/2021. The information about the research is described by the reviewers in Figure 1, presented in the flowchart, with a description of the search, selection, inclusion, and exclusion process. The articles were initially classified and analyzed by title and the ones that did not meet the research criteria were excluded. The following action was reading abstracts,

Chart 2. Criteria for inclusion and exclusion of studies according to PICOS, 2021

		Inclusion criteria	Exclusion criteria
P	Participants	Adult individuals undergoing treatment and post-treatment of head and neck cancer, of both sexes; older than 18 years old	Individuals with the presence of other diseases; Animal studies
I	Intervention	Any practice of physical activity, physical exercises, or body practices (dance, yoga, Pilates, and others)	Use of complementary drugs and/or supplements
C	Comparison	Control group. Intervention group	No group for comparisons
O	Outcome	Effects of physical activity, and/or physical exercise and body practices on the physical and psychological health of patients with head and neck cancer	-
S	Study	Randomized controlled trials	Systematic or literature reviews, case studies, study protocols, dissertations, theses, book chapters, abstracts presented in congresses, supplements or comments of the editor, and cross-references

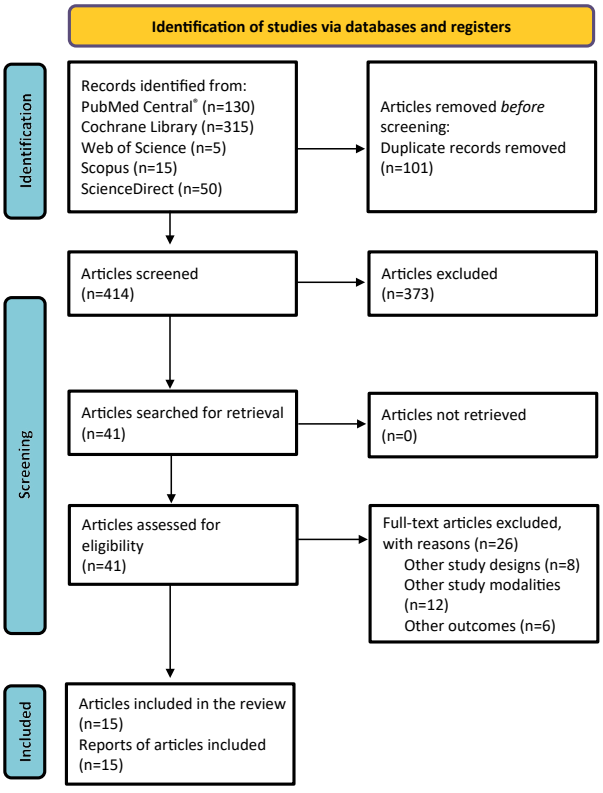

Figure 1. Flowchart of the study selection strategy, according to the PRISMA model, 2020

considering that articles in disagreement or duplicated were also removed. After the screening, the articles were read in full, so that the selection process of the studies would be completed.

After searching studies for the systematic review, those addressing the effects of physical activity and/or physical exercise interventions on physical health outcomes (hemoglobin, platelet count, functional capacity, physical fitness, body composition, neck and shoulder function, nutritional status, shoulder range of motion, joint mobility of upper limbs and pain) and psychological health (quality-of-life, anxiety, depression, fatigue, fear, restlessness, nervousness, sleep disorders, and concentration) in individuals with head and neck cancer were included.

According to the World Health Organization (WHO)[17], physical activity is defined as any body movement provided by skeletal muscles, thus generating energy expenditure. Regarding the complement to cancer therapies, physical exercise is clinically important to treatment, since it is accepted as a safe and effective method[16]. Therefore, at least 150 minutes of physical activity per week with moderate to vigorous intensity are recommended for cancer patients[18].

Complex treatments for head and neck cancer have the potential to cause significant limitations, including pain, fatigue, and dysphagia[19]. Moreover, they also result in a decrease in the physical function of the upper limbs, a reduction in nutrition and communication, as well as dissatisfaction with body image and restriction of daily tasks[20].

Head and neck cancer is considered one of the most psychologically traumatic cancers, due to the importance connected to the appearance of the head and neck[21]. Therefore, this type of cancer has the highest rates of major depressive disorders and it is associated with high levels of suffering[22].

The investigation and discussion of the results were conducted through the extraction of data referring to

the authors, year of publication, journal, the number of citations according to the Web of Science database (up to May 16, 2021), the number of databases, search period and followed up by the Checklist of 27 PRISMA items (yes or no). Next, it was obtained the objective, total sample size, age of the participants, intervention groups, control group, place of study, physical and psychological health investigated, characteristics of physical activity intervention and/or physical exercise, duration, number and frequency of sessions, intensity and duration of the intervention.

The Cochrane Collaboration tool[23] was used to evaluate the methodological quality of the studies. The following criteria were evaluated: (1) generation of random sequence, (2) allocation sequence concealment, (3) masking of participants and researchers, (4) selective reports, (5) masking of results evaluation, and (6) incomplete results data. The researchers' understanding in this systematic review was evaluated as low, unclear, or high risk of bias.

RESULTS

There were 515 articles in the first search in the database, 130 in PubMed Central®, 315 in Cochrane Library, 5 in Web of Science, 15 in Scopus and 50 in ScienceDirect. After sorting the title and abstract, 490 articles were excluded because they did not meet the inclusion criteria, they were namely cross-references, were characterized by another type of study, animal studies, to investigate individuals with other diseases, under 18 years old, and without physical activity and/or physical exercise intervention. After completing the reading, 26 articles were excluded, totaling 15 articles[4,10-12,14,24-33] included in this systematic review (Figure 1).

The study participants were all diagnosed with head and neck cancer in the laryngeal regions[4,10,12,29,30], oropharynx[4,12,28], tongue[29,31,33], mouth[10,12,27-30], retromolar trigone[29], epiglottis[29], amygdala[29], pharynx[10,12,27,30], nasopharynx[33], thyroid[25,31], parotid gland[31], hypopharynx[31,33], piriform sinus[31], paranasal sinuses[27] and salivary glands[27]. Five studies did not specify the region[11,14,24,26,32].

The age of the participants of the studies varied according to the inclusion criterion: over 18 years[10,27,28,30,33], from 18 to 75 years[25], over 20 years old[32], from 20 to 80 years[29], from 32 to 76 years[24] and six studies brought only the average age of the participants[4,11,12,14,26,31].

The participants of the studies varied between men and women, being 494 men and 176 women, totaling 670 individuals, the study of Samuel et al.[4] investigated the largest number of participants (n= 148 individuals) and Su et al.[29], the smallest number (n= 37 individuals).

Regarding the stage of the disease, eleven studies had the characterization of their participants in the primary stage of cancer[4,10,12,24,25,27-31,33] and the other four didn't bring that information[11,14,26,32].

Two studies brought participants who were submitted to the interventions receiving chemoradiotherapy[4,11], three of them after head and neck cancer surgery[14,29,31], one after radical neck dissection surgery[26], three after radiotherapy[10,28,33], one after chemotherapy[32], during adjuvant treatment[12], one after adjuvant treatment[30], one with complete adjuvant therapy treatment[24], one on medication with thyroid hormone after thyroidectomy[25] and one after receiving primary radiotherapy and surgery with adjuvant treatment with or without chemotherapy[27].

The year of publication of the studies was 2013[10,11], 2015[24,28], 2016[33], 2017[12,29], 2018[31], 2019[4,32] and 2020[14,26,27,30].

The studies were developed in Asia, in India[4,11,26], Taiwan[29,32], and South Korea[25,31]; in Europe, in Denmark[10,12,28,30], in Germany[14] and ending in North America in Canada[24,27,33].

Among the studies, only seven were registered in clinical trials platforms, in the Clinical Trials[10,12,28,30,33], German Clinical Trials[14] and Government of India clinical trial records[26].

It was observed that fourteen studies used control group, one study received, in the control group, recommendations to practice walking for 10 minutes, 5 days a week[4]; two received no intervention other than conventional care (cancer follow-up visits)[30,32]; one received standard clinical physiotherapy[14], two received standard hospital care[11,12], one received usual care offered by an oncologist and other health professionals as well as mouth opening exercises[28], two received home exercise program[29,31], two received 12 weeks of guidance only for self-directed activities, followed by 12 more weeks of intervention (resistance training)[10,33], one received exercises of muscular energy techniques[26], one received dynamic resistance exercises compatible with training volume[27], one received usual care, with postural exercises and strengthening[24] and finally a study provided no instruction[25].

The interventions were: aerobic exercises (walking)[4,11,25,32], endurance exercise[4,11,12,32]; physical therapies (including aerobic, anaerobic, and stretching therapies)[29]; yoga[30]; range of motion exercises, massage, stretching, and strengthening[26,31]; standard clinical physiotherapy exercises (mobilization movements)[14]; home exercise program with resistive training[25,33];

progressive endurance training[10]; exercises of stretching, postural and strengthening with maximum load and repetitions[24]; eccentric strength training with overload and neuromuscular electrical stimulation[27]; exercises for jaw mobility[28].

The period of interventions ranged from 10 days[26]; 4 weeks[31]; 5 to 6 weeks (during the period of radiotherapy treatment)[28]; 6 weeks[11]; 8 weeks[14]; 11 weeks[4]; 12 weeks[25,27,29,30,33]; 24 weeks[10]; 12 weeks[24] and a study did not specify[12].

The frequency proposed for interventions varied once a week[28], twice a week[33]; two and three times a week[12]; three times a week[24,27,31,32]; three to five days a week[25,29]; five days a week[4,11]; 30 sessions over 12 weeks[10], 3rd and 5th post-operative day[26] and two studies did not bring this information[14,30].

The duration of each session of the speeches ranged from 60 minutes[29]; 40 to 50 minutes[32]; 40 minutes[31]; 30 to 40 minutes[25]; 45 minutes[28] and ten studies did not specify the duration of the sessions[4,10-12,14,24,26,27,30,33].

The intensity of the interventions was light to moderate[4]; moderate[25,29,32,33]; vigorous[24] and nine studies did not report the intensity[10-12,14,26-28,30,31].

The intensity was evaluated using the Borg Rating of Perceived Exertion Scale[4,11,29,31], based on the American College of Sports Medicine, with the calculation of maximum frequency[32] and seven studies did not specify[12,14,26-28,30,33].

Among the professionals who performed the activities, there are physical therapists[14,26,28,31]; nutritionists[30]; clinical support with an exercise physiologist or personal trainer[33]; exercise specialist for cancer population[27]; support of physiotherapists and occupational therapists[12]; doctors and nurses[11]; academics and unsupervised professionals[10]; four studies were conducted at home and did not provide specifications on the professionals involved[4,24,25,29] and a study brought no information[32].

The interventions were performed in a hospital[31]; home[4,12,25,29,33]; home and rehabilitation center[30]; home and hospital[28]; physiotherapy department[14]; commercial training center facilities[10]; university[24,27] and three studies failed to report[11,26,32].

The outcomes evaluated were divided into physical and psychological health. All studies were proposed to evaluate participants in the baseline and post-intervention periods. Some studies included evaluations in the middle of the intervention, in the 3rd and 7th weeks[4], in the 12th week[33], on the 3rd and 5th day[26], and in the 6th week[29]. Studies including follow-up evaluations were also found between 5 and 12 months after the intervention[28], 36 and 48 weeks after the intervention[33], 2, 5 and 12 months after the intervention[12], 24 weeks[10], 12 months after intervention[24].

The physical outcomes evaluated in the clinical trial studies of this systematic review were functional capacity[4,10-12,29,30,33], hemoglobin and platelet count[4], range of motion[29], pain[12,26,29], body composition[10,12,30,32,33], neck and shoulder function[24,26,28,31], cardiovascular functions[14,32], physiological responses[32], respiratory function[14], skeletal muscle functions[14], digestive tract functions[14], nutritional status[12,33], neuromuscular function[27], trismus[12,28], aspiration and penetration[12], xerostomia (dry mouth)[12], muscle strength[10], level of physical activity[24] and immunological function[25].

The psychological outcomes evaluated in the clinical trial studies of this systematic review were quality-of-life[4,10,11,24,25,27,28,30,31,33], depression[30,33], anxiety[25,30], fear[14], restlessness[14], nervousness[14], sleep disorders[14] and concentration[14].

Therefore, in this section, the characteristics of the studies included in this review, as shown in chart 3 and 4 will be described.

The studies presented a higher risk of bias about "masking participants and team" and "other sources of bias" and most of them were classified as high and uncertain because they did not offer sufficient data for the evaluation. Nevertheless, it should be noted that the category that presented a low risk of bias was a "random sequence generation" where it was considered low for almost all studies. This item corresponds to the method used to generate the allocation sequence of participants randomly.

DISCUSSION

The physical health variables investigated in the studies included in this review were hemoglobin, platelet count, functional capacity, physical fitness, body composition, neck and shoulder function, nutritional status, range of movement, joint mobility, and pain, however, the most prominent in the studies were functional capacity, neck and shoulder function, joint mobility and range of movement, which corroborate the findings of Lynch et al.[13]. Studies[4,11,12,25,29,32,33] show that aerobic exercises such as walking combined with resisted exercises such as endurance training are presented in most of the studies since they have improved functional capacity, mobility, and cardiopulmonary capacity predominantly. Aerobic and endurance exercises alone improved muscle strength, physical fitness, nutritional status, shoulder range of movement, pain, and quality-of-life.

Exercises for jaw joint mobility also stood out in this review, since they relate to the needs associated with cancer location. Other interventions, as flexibility, stretching, and

Chart 3. Details of the selected studies concerning the participants and the control group/comparison group, 2021

	Author/year/ country	Total sample size	Age	Control group/Comparison group	Moment of treatment
1	Samuel et al., 2019 India	148 participants (131 men and 17 women)	Average age 52 years old	Control group: received physical treatment with recommendations of walking physical activity of 10 minutes, 5 days a week	Submitted to chemoradiotherapy
2	Su et al., 2017 Taiwan	37 participants (3 women and 34 men)	Average age 48 years old	Comparison group: HPB group: home program	Submitted to intervention after surgery
3	Kristensen et al., 2020 Denmark	71 participants (46 men and 25 women)	Average age 64 years old	Control group: did not receive intervention beyond standard care	Treated with radiotherapy
4	Do et al., 2018 South Korea	40 participants	-	Comparison group: Home-based group: Daily home exercises, with suggested times and through photos	Submitted to intervention after surgery
5	Yen et al., 2019 Taiwan	72 participants (15 women and 57 men)	Average age 53 years old	Control group: a sedentary group that received information on general health	Participants submitted to intervention after chemotherapy
6	Steegmann et al., 2020 Germany	69 participants (36 men and 33 women)	Average age 63 years old	Control group: received standard clinical physiotherapy	Postoperative
7	Capozzi et al., 2016 Canada	60 participants (49 men and 11 women);	Average age 56 years old	Comparison Group: 12-Week Late Lifestyle Group (DLI)	After radiotherapy
8	Hajdú et al., 2017 Denmark	69 participants (57 men and 12 women)	Average age 63 years old	Control group: received standard hospital care	Radiotherapy treatment
9	Samuel et al., 2013 India	48 participants (42 men and 6 women)	Average age 52 years old	Control group: received standard hospital care	During Chemoradiotherapy
10	Lønbro et al., 2013 Denmark	41 participants	Average age 55 years old	Comparison group: Group (ED): Progressive resistance training (maximum repetitions of leg press, knee extension, hamstring flexion, chest pressure, abdominal, back extension) after the beginning of the first 12 weeks	After radiotherapy
11	McNeely et al., 2015 Canada	52 participants (44 eligible) (67% men)	Average age 52 years old	Comparison group: TP group: usual care and postural exercises, strengthening exercises with light weights and elastic bands	Complete treatment of adjuvant therapy
12	Kim et al., 2018 South Korea	43 participants (7 men and 36 women)	Average age 50 years old	Control group: no intervention or instruction was provided	Treatment with thyroid hormone medication after thyroidectomy

to be continued

Chart 3. continuation

	Author/year/ country	Total sample size	Age	Control group/Comparison group	Moment of treatment
13	Thomas et al., 2020 India	48 participants (37 men and 9 women)	Average age 53 years old	Comparison group: Received exercises of muscular energy techniques (METS)	They underwent radical neck dissection surgery
14	Lavigne et al., 2020 Canada	22 participants (14 men and 8 women)	Average age 52,9 years old	Comparison group: CST group: involving dynamic resistance exercises compatible with the training volume	They received primary radiotherapy and surgery with adjuvant treatment with or without chemotherapy.
15	Høgdal et al., 2015 Denmark	97 participants (70 men and 27 women)	Average age 58 years old	Control group: usual care, which consisted of treatments and advice offered by the oncologist and other health professionals, including mouth opening exercises for approximately 10 minutes	Radiation therapy started

Chart 4. Details of selected studies about the characteristics of the interventions, physical and psychological health investigated, outcomes and instruments, 2021

	Author/ year	Intervention group	Total duration (number of weeks/ number of sessions)	Frequency	Session time	Intensity	Physical and psychological health investigated	Main outcomes	Instruments
1	Samuel et al., 2019	Aerobic exercises and active resistance exercises	11 weeks	5 days a week	-	Mild to moderate	Physical health: Functional capacity, hemoglobin, and platelet count. Psychological health: Quality-of-life and fatigue	There was a significant improvement in functional capacity ($p<0,001$), quality-of-life ($p<0,001$), and prevention of worsening fatigue ($p<0,001$), in the exercise group	Medical Outcomes Study 36-item (Short-Form Health Survey (SF-36)), Fatigue NCCN scale, 6 min Walking Test, Hemoglobin and Platelet Count
2	Su et al., 2017	Physical therapies, including aerobic, anaerobic, and stretching therapies	12 weeks	3-5 times a week	60 minutes	Moderate	Physical health: Functional capacity, shoulder range of motion, pain	The Home Program and Outpatient Physiotherapy can improve the functional capacity and range of motion of the shoulder. FACT H&N ($p=.074$), VAS of shoulder pain ($p=677$), 6MWT ($p=677$), and shoulder ROM ($p=145$ for flexion; $p=383$ for abduction)	Functional Assessment of Cancer Therapy - Head and Neck (FACT H & N) Visual Analog Scale (VAS), 6-minute walk test (6MWT), and Shoulder Range of Motion (SRM)

to be continued

Chart 4. continuation

	Author/ year	Intervention group	Total duration (number of weeks/ number of sessions)	Frequency	Session time	Intensity	Physical and psychological health investigated	Main outcomes	Instruments
3	Kristensen et al., 2020	Restorative yoga (balance or endurance training)	12 weeks	-	-	-	Physical health: Bodyweight and physical functions Psychological health: Quality-of-life, anxiety and depression	Had a positive effect physical function and quality-of-life. Quality-of-life ("Role functioning": p=0.041; "Speech problems": p=0.040; "Pain": p=0.048) in the intervention group	Quality-of-life Questionnaire (5D-5L(EQ-5D-5L)), Quality-of-life Questionnaire (EORTC QLQ-C30), Quality-of-life Questionnaire (EORTC QLQ-H&N 3), Quality-of-life Questionnaire (EQ-5D-5L), Analog visual scale (VAS) Hospital Anxiety and Depression Scale (HADS)
4	Do et al., 2018	Hospital-based group: Range of motion exercises, massage, stretching, and strengthening exercises	4 weeks	3 times a week	40 minutes	-	Physical health: Neck and shoulder function Psychological health: Quality-of-life	There was a significant difference in neck deficiency index and neck extension and rotation in the hospital-based group compared to the home-based group. (p<0.005)	Quality-of-life Questionnaire (EORTC QLQ-C30), the Quality-of-life Questionnaire (EORTC QLQ-H & N), Neck Disability Index Questionnaire (NDI), Digital inclinometer, and numerical classification scale (NRS)
5	Yen et al., 2019	Aerobic and endurance exercises	8 weeks	3 times a week	40 - 50 minutes	Moderate	Physical health: Body composition, cardiovascular physiological responses	Exercise can help promote cardiopulmonary fitness and exercise ability (p<0,05) in the intervention group	Walk test of 6 minutes
6	Steegmann et al., 2020	Individualized combinations with mobilization exercises	-	-	-	-	Physical health: Neurological functions, cardiovascular functions, respiratory functions, musculoskeletal functions, digestive tract functions. Psychological health: Fatigue, fear, restlessness, nervousness, sleep disorders, concentration	Patients with head and neck cancer therapy can benefit from an autonomous and individualized exercise plan. in the intervention group. Fatigue (p=0.048), digestive problems (p=0.009)	-

to be continued

Chart 4. continuation

	Author/ year	Intervention group	Total duration (number of weeks/ number of sessions)	Frequency	Session time	Intensity	Physical and psychological health investigated	Main outcomes	Instruments
7	Capozzi et al., 2016	Exercises performed at home (resistance training)	12 weeks	2 times a week	-	Moderate	Physical health: Body composition, physical fitness, and nutritional status Psychological health: Quality-of-life and depression	There was a slight improvement in quality-of-life, physical fitness, and nutritional status	Godin's leisure physical activity questionnaire, scale, absorptiometry, dynamometer, 6-minute walk test, Wells-Flexometer, Quality-of-life (FACT)-Anemia FACT-22 (FHNSI-22) , Epidemiologic Studies Depression Scale (CES-D), Global Subjective Evaluation (PG-SGA)
8	Hajdú et al., 2017	Swallowing exercises and progressive endurance training	-	2-3 times a week	-	-	Physical health: nutritional status body composition, mouth opening (trismus), physical function, pain, xerostomia Psychological health: Fatigue, quality-of-life, depression, and anxiety	Exercise according to the protocol is tolerable and feasible. No significant differences were seen between participants and decliners in any of the variables ($p > 0.05$)	Penetration aspiration score, sit test, and lift 30 sec., Bioimpedance, Range of Motion Scale, Functional Oral Intake Scale (FOIS), PS-ECOG Scale, Quality-of-life Questionnaire (EORTC QLQ-C30), (EORTC QLQ H&N 35) Short form-36 Questionnaire, Dysphagia Inventory (MDADI), Swallowing Screening (EAT-10), Numerical Rating Scale (NRS), Major Depression Inventory (MDI), Symptom Checklist (SCL-92)

to be continued

Chart 4. continuation

	Author/ year	Intervention group	Total duration (number of weeks/ number of sessions)	Frequency	Session time	Intensity	Physical and psychological health investigated	Main outcomes	Instruments
9	Samuel et al., 2013	Aerobic exercises and active resistance exercises	6 weeks	5 times a week	-	-	Physical health: Functional capacity. Psychological health: Quality-of-life	A walking and active exercise program is safe and well-tolerated by patients with head and neck cancer SF36 for the exercise group (4.8; $P<0.05$) the 6MWD ($P<0.001$) in the exercise group When 6MWD and SF36 were compared between the groups, there was a statistically significant difference ($P<0.001$) seen after six weeks	Health status questionnaire (SF-36), 6-minute walk test
10	Lønbro et al., 2013	Group (EE): Progressive resistance training	24 weeks	30 sessions over 12 weeks (each group)	-	-	Physical health: Lean body mass, maximum muscle strength, functional performance Psychological health: Quality-of-life	Progressive resistance training effectively increased lean body mass and muscle strength ($p<0.05$)	Dual Energy X-rays (DEXA), dynamometry, Full Speed Gait, 30 s Maximum Chair Lift, Ladder Climb, Maximum Arm Curves 30 seconds, Quality-of-life (EORTC QLQ-C30)
11	McNeely et al., 2015	PRET Group: usual care and exercises of stretching, postural exercises, exercises of strengthening with load, and maximum repetitions	12 months	3 times a week	-	Vigorous	Physical health: Mobility of shoulders, level of physical activity. Psychological health: Quality-of-life	Resistance exercise training can be a care intervention and support option for head and neck cancer survivors. Dissection-related functioning ($p=0.021$) and better QOL ($p=0.011$) than those who did not	Shoulder Pain and Disability Index (SPADI) Fatigue and Quality-of-life, Neck Dissection Impairment Index (NDII), Functional Assessment of Cancer Therapy - General (FACT-G), FACT-Anemia Scale (FACT-An)
12	Kim et al., 2018	Home exercises (through videos on mobile phones, with aerobic exercise instruction, resistance exercises, and flexibility exercises)	12 months	3-5 times a week	30-40 minutes	Moderate	Physical health: Immune function. Psychological health: Fatigue, anxiety, quality-of-life	The home exercise program is effective in reducing fatigue and anxiety, improving quality-of-life, and increasing immune function. In the intervention QV ($p<0.05$); the experimental group were significantly less fatigued or anxious ($p<0.01$)	Brief Fatigue Inventory (BFI), Hospital Anxiety-Depression Scale (HADS-A), Quality-of-life Questionnaire Core 30 (EORTC QLQ-C30)

to be continued

Chart 4. continuation

	Author/ year	Intervention group	Total duration (number of weeks/ number of sessions)	Frequency	Session time	Intensity	Physical and psychological health investigated	Main outcomes	Instruments
13	Thomas et al., 2020	Active range of motion exercise group	10 days	3rd and 5th postoperative day	-	-	Physical health: Shoulder width, pain	All individuals presented significant improvement in shoulder movement amplitude and also reduction of pain Both groups showed highly significant improvements in shoulder range of motion, decrease in pain and better Global Rating Change cores (GRCS) ($p=0.005$)	Universal goniometer, Numerical Rating Scale (NRS), Global Rating of Change Scale (GRCS)
14	Lavigne et al., 2020	NST group: eccentric strength training with overload and Neuromuscular Electrical Stimulation (NMES)	12 weeks	3 times a week	-	-	Physical health: Neuromuscular function Psychological health: Quality-of-life and fatigue	Both interventions improved anthropometric measurements, quality-of-life, and fatigue ($p<0.001$)	Blood pressure, electrocardiogram, Functional evaluation of head and neck cancer therapy, version 4 (FACT-H&N), Fatigue Questionnaire (FACT-Fatigue), Ultrasonography, Dynamometry, Cycloergometer, Sit-to-Stand Test 30sec.
15	Høgdal et al., 2015	7 exercises program for jaw mobility and also instructed to use sugarless chewing gum	5-6 weeks (period of radiotherapy treatment)	once a week	45 minutes	-	Physical health: Range of movement (trismus), cervical movement Psychological health: Quality-of-life	Early exercises combined with self-treatment focusing on mobility exercises to reduce trismus do not seem to provide additional beneficial effects compared to usual care during radiotherapy	Range of motion scale (Therabite), Digital Inclinometer, Quality-of-life Questionnaire (EORTC QLQ-C30), Quality-of-life Questionnaire (EORTC H&N 35)

Yoga were also applied, but without significant results for this population.

Among the psychological health variables, it is highlighted the quality-of-life, depression, anxiety, and fatigue, but others were also investigated as fear, restlessness, nervousness, sleep disorders, and concentration. As well as in physical health, the interventions that stood out most in the improvement of these symptoms were also aerobic exercises and resistance combined, which showed a significant improvement in the quality-of-life, anxiety, and fatigue. Thus, the findings in the literature reinforce that combined exercises (aerobic and resistance exercises) are efficient in other types of cancers, such as breast cancer, which improved quality-of-life and reduced fatigue effects[34], corroborating the data found in this review.

Yoga also improved the quality-of-life of head and neck cancer patients, similarly to other studies for individuals with breast cancer, such as Jong et al.[35] and Dhruva et al.[36], plus improvement in anxiety[36], quality of sleep[36,37] and reduction of fatigue[38,39].

In this systematic review, the analysis of the study by Lavigne et al.[27], indicated that the exercise intervention with the aid of neuromuscular electrical stimulation, besides the increase of the quality-of-life, brought benefits in fatigue reduction, as well as other studies which addressed the same intervention to individuals

with head and neck cancer resulting in improved swallowing, prevention of dysphagia[40], improvement of shoulder functions, in addition to pain reduction, proving effective for shoulder rehabilitation[41] with significant improvements in quality-of-life[42].

Most of the studies did not provide information about the time of the sessions and the intensity of the exercises, making it difficult to perceive their influence in the interventions and being a limitation for their replication. Bull et al.[6] state in their research that, performing 150-300 minutes of activity with moderate to vigorous intensity with a frequency of 3 to 5 days a week brings benefits to the physical and psychological health of individuals with cancer, meeting the studies in this review, where those who brought a more significant improvement for their participants were those who had the highest frequency (from 3 to 5 days per week) of physical activity and/or physical exercise[6].

In this sense, the practice of exercise offers benefits before, during, and after the treatment of cancer, in its various types and for various deficiencies related to it[43], which meets the results of this review, since the participants were mostly in the process of treatment or after treatment for head and neck cancer.

Some interventions were home-based without direct guidance. The assisted interventions counted with the presence of physical therapists and exercise professionals with or without expertise in cancer patients. In addition to home, the interventions were applied at hospitals/clinics, and training centers. It cannot be stated whether or not this factor influenced the results, because some studies, even with the help of a professional, did not obtain the expected benefits. Moreover, this meets the findings of the study by Cantwell et al.[44], which shows that there are some barriers health professionals have in promoting physical exercise programs for cancer patients, however, they play an important role in motivating individuals to adopt positive lifestyle changes.

Stout et al.[43] show that exercise when supervised produces great benefits if compared to unsupervised. On the other hand, Su et al.[29], Capozzi et al.[33], Samuel et al.[4], Hajdú et al.[12], and Kim et al.[25] studies applied home interventions, therefore, it can be implied that if the patient follows the appropriate guidelines, good results can be achieved. Considering that interventions with aerobic and resistance exercises are the most used for this population, with positive effects on quality-of-life and physical health in general which validates the findings of Lynch et al.[13], that also revealed that cancer head and neck survivors adhered to these activities in their routines.

According to the National Cancer Institute (INCA)[45] there is evidence that physical activity has a beneficial effect for people with cancer as it contributes to hormonal regulation, increased immunity and decrease oxidative stress from fat in addition to carcinogenesis[46]. There were also findings on the safety of physical activity for people with cancer, which were deemed as safe and well tolerated during and after treatment for various types of cancer[46,47].

There was a consensus among the studies[4,11,29,32,33] regarding the choice of the instrument for verification of physical health, wherein in a great part, the 6-minute Walk Test (6MWT) was used and considered an effective, low-cost and easy to apply tool in the evaluation of the functional capacity of healthy individuals or individuals with chronic diseases[48]. For psychological health, the instruments validated for individuals with head and neck cancer that stood out the most were the EORTC QLQ-C30, EORTC H&N 35, FACT H & N, and S-36[10,25,27-31]. These tools are also suitable for assessing the quality-of-life[49], aiming to understand the true impact of head and neck cancer in this population, enabling a better therapeutic choice, thus assisting in rehabilitation and psychosocial support[50].

As physical activity and/or exercise interventions cannot be blinded, as participants are aware of the type of intervention they are receiving as well as they need to understand the activity they are developing. Due to this, this item in the methodological quality of the studies had a high risk of bias, consequently, the study may be influenced by changes in the conduct of the research team or participants[51].

The information on intensity in the studies analyzed was scarce or non-existent, as well as volume and frequency, which decreases the quality since intensity is a primary variable to define the effectiveness of an intervention and meets the results of a systematic review of exercises in the cancer literature (2005-2017), where moderate and vigorous-intensity exercises may be equally better compared to low-intensity exercise interventions[43].

The reduced number of studies and protocols involving physical activity for the head and neck cancer population, as well as the lack of information on intensity, duration and frequencies of interventions, which may hinder the replicability of future interventions are some of the study limitations like the use of different instruments to verify the same variables which may bring unequal results.

CONCLUSION

It can be stated that physical activity interventions in individuals with head and neck cancer improve the symptoms evaluated in this population, but even so, there is a gap in the literature on that matter, especially those investigating psychological health. Therefore, it appears to be evident that further randomized controlled and

high-quality studies need to be carried out to determine the type, intensity, frequency, and ideal moment of physical activity interventions, as well as its impact on cancer prognosis. It is also considered that few studies of physical interventions and HNC survivors were found, with a limited number of samples, making methodological evaluation difficult.

However, when considering the use of these interventions for clinical use, there is a gap in including therapeutic treatments in complementation of the traditional ones, corroborating the findings in this review, indicating that the practice of physical activity can contribute to the improvement of the health of cancer survivors potentially mitigating the likely side effects of pharmacological therapies and possibly achieving a better response to the treatment as a whole.

The present study is strong in its assertions as it may contribute to future investigations considering the information about interventions practice. Moreover, it suggests that psychological variables should be further studied due to possible complications caused by the disease. It is beneficial as well for health professionals and the scholar community making clear the relevance of physical exercise and physical activity. More studies are necessary on that matter.

CONTRIBUTIONS

Patrícia Severo dos Santos Saraiva and Juliana da Silveira contributed to the study design, acquisition, analysis and interpretation of the data, wording and critical review. Jéssica Amaro Moratelli, Kettlyn Hames Alexandre, Mirella Dias and Adriana Coutinho de Azevedo Guimarães contributed to the study wording and critical review. They approved the final version to be published.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interests to declare.

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