Effect of Combination Versus Indirect Swallowing Exercises on Dysphagia among Patients had Head and Neck Cancer Receiving Radiotherapy.

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Abstract

Background: Dysphagia is one of the most frequent side effects of radiotherapy for head and neck cancer, which has an adverse influence on the quality of life and health of survivors. **Aim:** to investigate the effect of combination versus indirect swallowing exercises on dysphagia among patients had head and neck cancer receiving radiotherapy. **Design:** A quazi–experimental/interrupted time-series with nonequivalent control group. **Setting**: radiotherapy department at one of the teaching hospital, Cairo, Egypt. **Sample:** A purposive sample of 90 patients with head and neck cancer undergoing radiotherapy, divided into 3 matched groups. control group (G1), first and second study groups (G2& G3). **Tools:** 1- Demographic and Medical History Data Sheet ; 2-Swallowing Disturbance Questionnaire (SDQ); 3-Dysphagia Handicap Index (DHI) questionnaire. **Results**: there was a statistically significant differences between studied groups regarding swallowing disturbances and Dysphagia Handicap Index at second- and third-week follow-up. **Conclusion:** swallowing exercise had a positive effect on swallowing disturbances and Dysphagia Handicapping index in head and neck cancer patients undergoing radiotherapy. **Recommendation:** Head and neck cancer patients undergoing radiotherapy should be encouraged to perform swallowing exercise before and along the period of radiotherapy.

Keywords: Dysphagia, Head and Neck Cancer, Radiotherapy, Combination, and Indirect Swallowing Exercise.

Introduction

Head and neck cancer (HNC) may present at various anatomic sites in the region including the oral cavity/pharynx, larynx, nasopharynx, nasal cavity/paranasal sinus, and hypopharynx **(American Speech and Hearing Association, 2022; Pickens, 2019).** Although radiation therapy protocol has been designed to preserve swallowing function and essential speech organs for head and neck cancer patients, dysphagia is a frequent symptom in those patients and the primary adverse effects are usually associated with acute or late swallowing. Cancer is a major global health burden and is the second leading cause of death worldwide (**Bernicker, 2019**). It accounts for 19.3 million new cancer cases and almost 10 million cancer deaths occurred in 2020. The cost to health care associated with cancer care is significant and has been shown to exceed costs for other common diseases such as cardiovascular disease, diabetes, mental health, and trauma (**Sam & Cheung, 2019; Sung et al., 2021).**

On the same line, (Patterson & Lawton, 2023) added that dysphagia is a common and widely reported complication after radiotherapy for head-and-neck cancer patients and can persist for a long period of time. Fifty to 60% of the head-and-neck cancer patients undergoing radiotherapy may experience significant post-treatment dysphagia.

Radiation induced dysphagia pathogenesis includes an initial process of acute inflammation with the appearance of edema, which may be followed by fibrosis of the soft tissues resulting in neurological alteration and muscle damage. Moreover, radiotherapy may result in lack of swallowing abilities and coordination with the respiratory function, reduced elevation of larynx, delayed laryngeal closure, loss of tongue strength, and prolonged oral and pharyngeal time in swallowing (**Guillen-Sola et al., 2019**).

Furthermore, the medical consequences of dysphagia may be feeding-tube dependency, malnutrition, and aspiration pneumonia that have a major negative impact on daily

functioning and health-related quality of life (QoL) of the patients and can even be life-threatening condition (**Govender et al., 2017**). These consequences and the high prevalence of swallowing disorders in head and neck cancer patients stress the importance of prevention, monitoring and management of the dysphagia (**Baudelet et al., 2020**). There is no specific pharmacological treatment for dysphagia. The main management is rehabilitation. During the last decade, the use of swallowing exercises in patients treated with radiotherapy for head-and-neck cancer is gaining more interest. The rationale behind these strategies is prevention of weakness and disuse atrophy of the swallowing musculature. Previous research showed that swallowing therapy can lead to less muscle atrophy and an improved dysphagia-related QoL with less aspiration, less feeding tube dependency and less hospitalization post-treatment (**Baudelet et al., 2024**).

The components of the rehabilitation program for patients with dysphagia are multiphasic. These include a dietary change that alters the consistency of solids and liquids for easy and safe ingestion; change the position of the head and neck to facilitate the flow of the bolt under gravity; introduce swallowing techniques that prevent pocketing of bolus and protecting the airway; oral motor exercises designed to strengthen and coordinate the muscles of the oral structure (**Yousef, El-Deeb, & Rady , 2020**).

Several studies have found positive results of applying swallowing exercises for head and neck cancer patients who had dysphagia with varying degrees in functional outcomes. Specifically, some of these studies suggested that patients who underwent radiotherapy and adhered to a swallowing exercise program during and/or after treatment returned to an oral diet sooner, had improved weight gain, shorter duration of gastrostomy tube use, and/or exhibited higher quality of life scores. Additionally, less floor of mouth muscle deterioration with the implementation of prophylactic swallow exercise protocols has also been shown (**Messing et al., 2017**).

Exercise rehabilitation has long been a treatment for patients with dysphagia. A variety of exercises exist, ranging from direct to indirect, isolated to combined and those incorporating swallowing or non-swallowing exercise. Combining swallowing exercises are a combination of direct and indirect swallowing exercises (exercises that require swallowing). They include Masako and supraglottic maneuver. While indirect swallowing exercises are exercises do not require swallowing. They include lingual and jaw range of motion exercises (**Langmore & Pisegna, 2015**).

Masako maneuver is an oro-pharyngeal exercise rehabilitation technique mainly performed to strengthen its function of pushing food boluses from the oral cavity to the pharynx by strengthening the contact between the tongue base and the laryngo-pharyngeal wall (Byeon, 2016). While **supraglottic** maneuver had an effect to bring the vocal folds together before and during the swallow, hence providing a mechanical barrier to penetrated aspirated material (Paik & Dawodu, 2020). On the other hand, **lingual** strengthening exercises are designed to improve the driving pressures of the tongue during the swallow, increase musculature, and improve bolus control and residue clearance (Pickens, 2019). **Jaw** range of motion exercises is used to improve hyoid bone movement and opening of the upper esophageal sphincter, so facilitate swallowing of food (**Bae, Jin & Ji-Su, 2020)**.

Effective nursing interventions for dysphagia are essential to reduce the risk of complications related to dysphagia. Often, the nurse is the first member of the medical team responsible for detecting and assessing the signs and symptoms of dysphagia. In addition, the nurse has a significant role in assessing the intensity of dysphagia using standardized tools and can effectively apply different types of exercises and measure its effectiveness in relieving dysphagia and improving swallowing ability in patients with head and neck cancer. Therefore, in this study, the researchers are interested to investigate the effect of combination versus indirect swallowing exercises on dysphagia among patients had head and neck cancer receiving radiotherapy at a selected university hospital.

Significance of the study:

Head and neck cancer (HNC) is the sixth most common human malignancy accounting

for 3% of all cancers worldwide (Azzam et al., 2020). It accounts for approximately 900,000 cases and over 400,000 deaths annually (**Global Cancer Observatory, 2021**). In the United States, head and neck cancer accounts for 3 % of all cancers, with 66,000 cases annually and 15,000 deaths (Siegel et al., 2022). In Egypt study done by (**Attar et al., 2010**) reported that head and neck cancer account for about 17–20% of all cancers.

From the clinical experience of the researchers, they found that patients had HNC report significant difficulty eating solid foods, swallowing, choking, and coughing after the swallow, spending more time-consuming food and weight loss which exacerbate with treatment intensification. Head and neck cancer also has a profound impact on the social well-being of patients, such as altered social interactions, loss of enjoyment with eating, embarrassment, and dissatisfaction throughout treatment and even after completion of a therapy.

Swallowing exercises are a set of exercises given to the patients to complete throughout and after cancer treatment that may target range of motion or strengthening of the tongue, jaw, or pharyngeal muscles. The goal of those exercises is to encourage patients to continue use of their swallowing mechanism, as many patients stop eating and drinking by mouth due to toxicities of treatment. Disuse of the system can lead to muscular atrophy, furthering the severity of dysphagia. Moreover, combining swallowing exercises as masako and superglotic maneuver and indirect swallowing exercises such as lingual and jaw range of motion exercises had positive results and evidence to reduce the incidence and severity of dysphagia. So, it was relevant to investigate the effect of combination versus indirect swallowing exercises on dysphagia among patients with head and neck cancer receiving radiotherapy to identify which one of them is more effective to improve swallowing abilities than other exercises or both of them have the same effect to reduce intensity of dysphagia; specially there are few number of researches have been conducted on the effect of combining and indirect swallowing exercises on dysphagia worldwide and in Egypt. Therefore, hoping that the result of the current study helps nurses to assess intensity of dysphagia, provide the required care for relieving or reducing the severity of dysphagia, use different types of swallowing exercises for managing dysphagia and alleviate patients suffering from the side effects of the medications used for head and neck cancer. Moreover, it is hoped that the findings of this study might help in improving quality of patients care and establish evidence-based data that can promote nursing practice and research.

Methods

Aim of the study

The current study aimed to investigate the effect of combination versus indirect swallowing exercises on dysphagia among patients had head and neck cancer receiving radiotherapy.

Research hypotheses:

In order to accomplish this study aim, four hypotheses were formulated:

H1: The intervention groups who receive either combination or indirect swallowing exercises will have a significantly lower mean swallowing disturbance scores compared to the control group who receives routine hospital care.

H2: The intervention groups who receive either combination or indirect swallowing exercises will have a significantly lower mean dysphagia handicapping scores than the control group who receives routine hospital care.

H3: There will be a difference between applying combination versus indirect swallowing exercises on mean swallowing disturbance scores among the intervention groups

H4: There will be a difference between applying combination versus indirect swallowing exercises on mean dysphagia handicapping scores among the intervention groups.

Operational definitions

- Dysphagia: For the current study, any patient with head and neck cancer who reported that he/she had difficulty in swallowing liquid/soft, hard food or saliva by using Swallowing Disturbance Questionnaire.

- Combination Swallowing exercises: They are a combination of indirect

and direct swallowing exercises (exercises that require swallowing). They include Masako and supraglottic maneuver for 5-10 minutes of 10-15 repetitions for 3 times a day for 7 days per week.

- Indirect Swallowing exercises: They are exercises do not require swallowing, they include lingual and jaw range of motion exercises for 3- 5minutes of 10 repetitions for 3times a day for 7 days per week.

- Head and neck cancer: It refers to patients newly diagnosed with head and neck cancer receiving radiotherapy treatment for the first time during the first week of their admission to the hospital.

Research Design

A quazi–experimental/interrupted time-series with nonequivalent control group design was utilized to guide and achieve the aim of the current research.

Setting

This study was conducted at one of the teaching hospital, Cairo, Egypt, which provide medical treatment including radiotherapy for patients with head and neck cancer.

Sample

The research sample included all the patients admitted to a teaching hospital at one of the university hospitals in Cairo governorate, Egypt; who met the following inclusion criteria: (1) Patients newly diagnosed with head and neck cancer receiving radiotherapy treatment for the first time during the first week of their admission to the hospital, (2) Adult male and female patients their ages ranged from 20 to less than 60 years old, (3) Conscious patients and able to communicate with the researchers. While exclusion criteria included: (1) Surgical treatment on head and neck cancer areas (2) receiving another type of cancer treatment (3) dysphagia due to causes other than cancer.

A purposive sample of 90 male and female adult patients constituted the study sample. Those who met the inclusion criteria were invited to share in the research. Patients randomly allocated into three groups by using patient's bed code number as the odd code number of patient' s bed assigned in the control group (G1), and the even code number of patient's bed in the right side of the department assigned in the first study group(G2). In addition, the even code number of patient' s bed in the left side of the department assigned in the second study group (G3) and so on, utilizing this technique to complete the number of patients.

The three groups investigated in this study were:

Control group [G1, n = 30], who received the routine hospital care and the first intervention group [G2, n =30], who followed routine hospital care alongside combination swallowing exercises which included masako and supraglottic maneuver. While the second intervention group [G3, n =30], who followed routine hospital care alongside indirect swallowing exercises which included lingual and jaw range of motion exercises.

Data collection tools

In order to accomplish the aim of the study, three instruments were used to collect the data:

1.Demographic and Medical History Data Sheet: This sheet was designed by the researchers to collect the baseline characteristics and medical data of the patients, it had 2 parts: part (1) related to demographic data such as; age, gender, marital status,…. and part (2) related to medical data such as duration of the disease, co morbid diseases, …….etc.

2. Swallowing Disturbance Questionnaire (SDQ); it is an adopted tool developed by **(**Manor &Cohen , 2011), it aims to assess swallowing difficulty. It consists of 15 questions. Question 1 to 14 on a scale of 0=Never, 1=Seldom **(**once a month or less), 2=Frequently (1-7 times a week) and 3=Very frequently (> 7 times a week) , while question 15 is either 0-no or 1=yes. 0 means no swallowing disturbance, 1-14 means seldom swallowing disturbance, 15-28 means frequently swallowing disturbance and 29-42 means very frequently swallowing disturbance. The reliability of SDQ was established as the total SDQ score correlated with the total oromotor scores with 79.7% sensitivity **(Manor &Cohen , 2011**). The reliability of the Arabic version of this tool will be established after data collection from the patients, it was (0.98).

3.Dysphagia Handicap Index (DHI) questionnaire: it is an adopted tool developed by **(**Silbergliet, Schultz, Jacobson, Beardsley & Johnson, 2012). It measures the handicapping effect of dysphagia on the physical, functional and emotional aspects of patient's lives. It

consists of 25 statements divided into three domains: physical, functional and emotional aspects of dysphagia. **Physical problems of dysphagia (9 items)**, i.e., how the patient perceives the physical discomfort caused by dysphagia; calculated as 0 means no physical problems related to dysphagia, 2-18 means sometimes physical problems related to dysphagia, and 20- 36 means always physical problems related to dysphagia. **Functional problems of dysphagia (9 items)**, i.e., how dysphagia impacts the patient's daily activities; calculated as 0 means no functional problems related to dysphagia, 2-18 means sometimes functional problems related to dysphagia, and 20- 36 means always functional problems related to dysphagia. **Psychological problems of dysphagia** (7 items), i.e., the affective response caused by dysphagia, calculated as 0 means no emotional problems related to dysphagia, 2-14 means sometimes emotional problems related to dysphagia, and 16- 28 means always emotional problems related to dysphagia.

For each statement, the patient checked whether it applied to him/her all the time, some of the time, or never, with a suggested scoring of 0, 2, and 4, respectively. Using this scoring system gives the DHI score a range of 0–100, with higher scores meaning worse QoL. Cronbach's α reliability was from 0.82 to 0.94 (Asadollahpour, Baghban & Asadi, 2015). The reliability of the Arabic version of this tool was established after data collection from the patients, it was (0.97).

Ethical considerations

Initial written approval obtained from the Research Ethics Committee of the Faculty of Nursing- Cairo University **(IRB 0006883).** Official permission also obtained from the head of the department in the hospital. Written informed consent attained from each patient after explaining the nature and the purpose of the study. Researchers emphasized that participation in the study was voluntary. Confidentiality of patient assured through coding of all data. In addition, the patients informed that they have the right to refuse or withdraw from the study at any time without giving a reason and without affecting their treatment.

Procedure of the study

Once official permission was granted from the appropriate authoritative personnel in the college and the head of the department in the hospital, the proposed study proceeded and conducted. Data collection started from January 2023 to April 2024. Patients who met the inclusion criteria interviewed individually, and randomly allocated into three groups by using patient's bed code number as mentioned earlier to the control group (G1) who received the routine hospital care, the first intervention group (G2) and the second intervention group (G3).

This study was conducted in three phases as the following:

Assessment phase*:* The researchers interviewed the patients, who met the inclusion criteria and were willing to participate in the study and explained the nature and the aim of the study, to obtain their informed consent. At this phase, demographic and medical data sheet, swallowing disturbance questionnaire as well as dysphagia handicap index (DHI) questionnaire were filled by the researchers, it takes about 20 to 30 minutes to obtain baseline data from each participant in the study. **Implementation phase:** at this phase, the researchers applied combination swallowing exercise that included masako and supraglottic maneuvers for the first intervention group (G2).

Masako maneuver include, requesting the patient to sit or stand comfortably, stick the tongue out as far as is comfortable, hold the tongue gently between the front teeth, and then swallow, and let go of the tongue. This exercise will be done 10 times in a row, 3 times per day, 7 days per week.

Supraglottic maneuver include, requesting the patient to inhale deep, then hold the breath for 3 to 5 seconds, then swallow, immediately after the swallowing (before the next inhalation), cough out as strong as possible then immediately swallow again.This exercise was done 10 times in a row, 3 times per day, 7 days per week.

Indirect swallowing exercise include lingual and jaw range of motion exercises applied for the second intervention group (G3).

Lingual range of motion exercises include, asking the patient to stick out the tongue and move it up towards the nose and then down towards the chin, stretch as far as the patient can in both directions, hold for 5 seconds for both directions then move the tongue to the left side, hold for 5 seconds and move the tongue to the right side, hold for 5 seconds. All steps repeated 10 times, 3 times per day, 7 days per week.

Jaw range of motion exercises include the following steps, asking the patient to open his mouth as far as the patient can and hold for 2-3 seconds, close and repeat, then move the jaw from side to side as far as the patient can each way. This exercise repeated 10 times, 3 times per day, 7 days per week.

Considering that, if the patient reported any discomfort or pain, the intervention discontinued immediately, and the patient monitored until he/she feel much more better. For patients who were unable to complete 10 repetitions of a specific exercise initially, a gradual increment in repetitions was implemented. patients in G2 and G3 received a single 30-minute training session, incorporating demonstration, redemonstration to ensure the proper performance of the specified exercises. The patients were instructed to perform these exercises daily from the first to third week of radiotherapy. To enhance adherence and retention, the patients received instructional flyers in Arabic, included visual aids and detailed descriptions of the exercises and its benefits as well as daily follow up phone calls.

Evaluation phase: Patients were followed up for three weeks. Swallowing disturbance questionnaire as well as dysphagia handicap index (DHI) questionnaire were filled by the researchers for control group and after each intervention of swallowing exercises for both two study groups and the readings by the end of the 1st week were considered as the 1st post intervention reading, the readings by the end of the 2nd week were considered as the 2nd post intervention reading, and the readings by the end of the 3rd week were considered as the 3rd post intervention. Reading was done for the two study groups and the control group who received routine hospital care alongside radiotherapy treatment.

Data analysis

The collected data was scored, tabulated and analyzed by personal computer using statistical package for the social science (SPSS) program version 23. Descriptive as well as inferential statistics utilized to analyze data pertinent the study. Moreover, ANOVA used to compare results of more than two groups. Level of significance was adopted at $p \leq 0.05$.

Results

Results of the current study are presented into three sections. Section (I) Highlighted the description of the study samples' demographic characteristics, and medical data related to head and neck cancer disease (Tables 1 and 2). Section (II) Delineated hypothesis testing for being supported or not (Table 3 to 6) and (Figures 1 to 4). Section (III) clarified other additional findings such as the correlation between age, duration of head and neck cancer, BMI, and swallowing disturbances with duration of dysphagia, and physical, functional, and psychological problems related to swallowing disturbances (Table 7).

Section I: Description of the study samples' demographic characteristics, and medical data related to head and neck cancer disease of the control and the two intervention groups.

Table (1) shows that (63.4%, 56.7%, and 60.0% respectively) of the control, combination and indirect swallowing exercises groups their age ranged from 50 to less than or equal 60 years with mean of age (49.43 $\pm$ 6.399) for the control group, (49.03$\pm$5.828) for combination group, and (49.50$\pm$6.431) for indirect swallowing exercises group. Male gender constitutes (56.7%, 63.3%, and 60.0%respectively) of the control, combination, and indirect swallowing exercises groups. Regarding marital status, (73.3%, 80.0%, 76.7% respectively) of the control, combination and indirect swallowing exercises groups were married. In relation to residence, (56.7%, 60.0%, and 53.3% respectively) of the control, combination and indirect swallowing exercises groups had lived in urban region. According to education level, (46.7%) of the control group and (50.0%) of indirect swallowing exercises group had secondary degree. While (50.0%) of

combination swallowing exercises group had university degree. With reference to occupation, (36.7%) of the control group were housewives, (40.0%) of combination, (36.7%) of indirect swallowing exercises groups were employees. Moreover, (66.7%, 76.7%, and 70.0% respectively) of the control, combination and indirect swallowing exercises groups were non-smokers. There was no statistically significant difference among the three study groups regarding demographic variables.

Table (2) clarifies that (63.3%, 76.7%, and 70.0%respectively) of the control, combination and indirect swallowing exercises groups had head and neck cancer from 1 to less than 5 months. According to duration of dysphagia (40.0%, 50.0%, `and 43.3% respectively) of the control group, combination and indirect swallowing exercises groups had dysphagia from more than 1 to less than or equal 3 months. Moreover, (63.3%, 70.0%, 66.7% respectively) of the control, combination and indirect swallowing exercises groups had no family history of head and neck cancer. In addition (43.3%, 46.7%, and 50.0% respectively) of the control, combination and indirect swallowing exercises groups had above normal BMI. In relation to recent weight loss, (76.7%, 73.3%, and 66.7% respectively) of the control, combination and indirect swallowing exercises groups had recent weight loss. With reference to comorbid diseases, (33.3%, 36.7%, and 33.3% respectively) of the control, combination and indirect swallowing exercises groups had diabetes mellitus. There was no statistically significant difference among the three study groups regarding medical data.

Section II: Delineates hypothesis testing for being supported or not

Table (3) represents that (50.0%, 46.7%, and 53.3% respectively) of the control, combination and indirect swallowing exercises groups had frequently swallowing disturbances before intervention. After 1 week of swallowing exercises (50.0%, 40.0%, and 46.7% respectively) of the control, combination and indirect swallowing exercises groups had frequently swallowing disturbances. After two weeks of swallowing exercises (43.3%, and 50.0% respectively) of the control and indirect swallowing exercises groups had frequently swallowing disturbances. While (56.7%) of the combination group had seldom swallowing disturbances. After 3 weeks of swallowing exercises (50.0%) of the control and indirect swallowing exercises groups had frequently swallowing disturbances. While (56.7%) of the combination group had seldom swallowing disturbances. There was no statistically significant difference among the three groups before intervention and after 1 week of swallowing exercises. While there were statistically significant differences among the three groups after two weeks of applying swallowing exercises as (χ^2 =9.404, p=0.05) and also after three weeks of applying swallowing exercises as (χ^2 =9.909, p=0.042).

Table (4) denotes that (43.3%, 53.3%, and 53.3% respectively) of the control, combination and indirect swallowing exercises groups had sometimes physical problems related to dysphagia before intervention. **After 1 week** of swallowing exercises (50.0%, 40.0%, and 46.7% respectively) of the control, combination and indirect swallowing exercises groups had sometimes physical problems related to dysphagia. **After two weeks** of swallowing exercises (43.3%, and 50.0% respectively) of the control and indirect swallowing exercises groups had sometimes physical problems related to dysphagia. While (53.3%) of the combination group had no physical problems related to dysphagia. **After 3 weeks** of swallowing exercises (53.3%, 50.0% respectively) of the control and indirect swallowing exercises groups had sometimes physical problems related to dysphagia. While (56.7%) of the combination group had no physical problems related to dysphagia. There was no statistically significant difference among the three groups before intervention and after 1 week of swallowing exercises. While there were statistically significant differences among the three groups after two weeks of applying swallowing exercises as (χ^2 =9.811, p=0.044) and also after three weeks of applying swallowing exercises as (χ^2 =11.850, p=0.019).

Table (5) shows that (40.0%, 46.7%, and 50.0% respectively) of the control, combination and indirect swallowing exercises groups had sometimes functional problems related to dysphagia before intervention. **After 1 week** of swallowing exercises (46.7%, 36.7%, and

50.0% respectively) of the control, combination and indirect swallowing exercises groups had sometimes functional problems related to dysphagia. **After two weeks** of swallowing exercises (53.3%, 43.3%, and 50.0% respectively) of the control, combination and indirect swallowing exercises groups had sometimes functional problems related to dysphagia. **After 3 weeks** of swallowing exercises (50.0%) of the control and indirect swallowing exercises groups had sometimes functional problems related to dysphagia. While (53.3%) of the combination group had no functional problems related to dysphagia. There was no statistically significant difference among the three groups before intervention and after 1 and 2 weeks of applying swallowing exercises. While there were statistically significant differences among the three groups after three weeks of applying swallowing exercises as (χ^2 =10.391, p=0.034).

Table (6) clarifies that (43.3%, 50.0%, and 50.0% respectively) of the control, combination and indirect swallowing exercises groups had sometimes psychological problems related to dysphagia before intervention. **After 1 week** of swallowing exercises (40.0%, 43.3%, and 46.7% respectively) of the control, combination and indirect swallowing exercises groups had sometimes psychological problems related to dysphagia. **After two weeks** of swallowing exercises (43.3%, 46.7%, and 50.0% respectively) of the control, combination and indirect swallowing exercises groups had sometimes psychological problems related to dysphagia.

After 3 weeks of swallowing exercises (43.3%, and 50.0%) of the control and indirect swallowing exercises groups had sometimes psychological problems related to dysphagia. While (53.3%) of the combination group had no psychological problems related to dysphagia. There was no statistically significant difference among the three groups before intervention and after 1, 2, and 3 weeks of applying swallowing exercises.

Figure (1) shows that mean and standard deviation of swallowing disturbances before intervention was (26.60± 8.900) for control group, (24.87± 8.885) for combination swallowing exercise group and (26.47± 8.681) for indirect swallowing exercise group. Mean and standard deviation of swallowing disturbances **after 1 week** of applying swallowing exercises was (25.47 ± 8.357) for control group, (21.93± 8.694) for combination group and (24.73± 8.526) for indirect group. Mean and standard deviation of swallowing disturbances **after 2 weeks** was (25.33 ± 8.389) for control group, (17.77± 7.780) for combination group and (21.83± 7.983) for indirect swallowing exercise group. Mean and standard deviation of swallowing disturbances **after 3 weeks** was (25.40 ± 8.286) for control group, (16.10± 6.702) for combination group and (21.30± 7.983) for indirect swallowing exercise group. There were statistically significant differences between control and combination swallowing exercise group at 2nd week (t=3.622, p value =0.001) and at 3rd week (t=4.780, p value =0.000) and also between control and indirect group at 3rd week of intervention (t= 1.952, p value=0.05). Moreover, there were statistical significance differences between combination and indirect group at 2nd week (t= 1.998, p value=0.05) and at 3rd week (t=2.732, p value=0.008). ANOVA value was F (df: 2.711) = 46.048. P value was 0.000. P-value$\leq$ 0.05 is significant at two tailed.

Figure (2) denotes that mean and standard deviation of physical problems related swallowing disturbances before intervention was (15.40± 4.173) for control group, (10.93± 3.552) for combination group and (13.13± 4.877) for indirect swallowing exercise group. Mean and standard deviation of physical problems related to swallowing disturbances **after 1 week** of applying swallowing exercises was (14.80 ± 5.039) for control group, (9.73± 3.595) for combination group and(12.13± 3.866) for indirect group. Mean and standard deviation of physical problems related to swallowing disturbances **after 2 weeks** was (14.73 ± 4.889) for control group, (7.67± 1.129) for combination group and (10.27± 2.679) for indirect group. Mean and standard deviation of physical problems related to swallowing disturbances **after 3 weeks** was (14.07 ± 4.299) for control group, (6.20± 1.937) for combination group and (9.73± 2.679) for indirect swallowing exercise group. There were statistically significant differences between control and combination swallowing exercise

group at 2nd week (t=2.876, p value =0.006) and at 3rd week (t=3.524, p value =0.001) and also between control and indirect group at 3rd week of intervention (t= 1.968, p value=0.05). Moreover, there were no statistical significance differences between combination and indirect swallowing exercise group. ANOVA value was F (df: 1.937) = 30.055. P value was 0.000. P-value ≤ 0.05 is significant at two tailed.

Figure (3) clarifies that mean and standard deviation of functional problems related to swallowing disturbances before intervention was (14.93± 3.553) for control group, (11.73± 2.566) for combination group and (13.20± 4.923) for indirect group. Mean and standard deviation of functional problems related to swallowing disturbances **after 1 week** of applying swallowing exercises was (13.47 ± 3.556) for control group, (10.47± 2.652) for combination group and (12.20± 3.779) for indirect group. Mean and standard deviation of functional problems related to swallowing disturbances **after 2 weeks** was (14.47 ± 2.652) for control group, (9.67± 1.791) for combination group and (11.80± 2.732) for indirect group. Mean and standard deviation of functional problems related to swallowing disturbances **after 3 weeks** was (14.07 ± 3.447) for control group, (6.73± 1.670) for combination group and (9.67± 1.721) for indirect swallowing exercise group. There were statistically significant differences between control and combination swallowing exercise group at 3rd week (t=3.133, p value =0.003) and also between control and indirect group at 3rd week of intervention (t= 1.975, p value=0.05). Moreover, there were no statistical significance differences between combination and indirect swallowing exercise group. ANOVA value was F (df : 2.571) = 13.159 . P value was 0.000. P-value≤ 0.05 is significant at two tailed.

Figure (4) shows that mean and standard deviation of psychological problems related to swallowing disturbances before intervention was (12.63± 2.686) for control group, (9.47± 1.959) for combination group and (11.67± 2.421) for indirect group. Mean and standard deviation of psychological problems related to swallowing disturbances **after 1 week** of applying swallowing exercises was (12.67 ± 2.253) for control group, (9.00± 1.300) for combination group and (11.60± 2.573) for indirect group. Mean and standard deviation of psychological problems related to swallowing disturbances **after 2 weeks** was (13.03 ± 2.394) for control group, (8.33± 1.411) for combination group and (10.53± 2.237) for indirect group. Mean and standard deviation of psychological problems related to swallowing disturbances **after 3 weeks** was (12.90 ± 2.564) for control group, (7.27± 1.733) for combination group and (10.33± 2.356) for indirect exercise group.

Statistically significant differences were found between control and combination swallowing exercise group only at the 3rd week of intervention (t=2.382, p value =0.021). No statistically significance differences were observed between control and indirect swallowing exercise group or between combination and indirect swallowing exercise groups during the rest of the assessment points. ANOVA value was F (df : 1.695) = 2.819 . P value was 0.039. P-value≤ 0.05 is significant at two tailed.

Figure (5) indicates that mean and standard deviation of total dysphagia handicap scores before intervention was (42.97± 20.479) for control group, (32.13± 15.462) for combination swallowing exercise group and (38.0 ± 17.003) for indirect swallowing exercise group. Mean and standard deviation of total dysphagia handicap scores **after 1 week** of applying swallowing exercises was (40.93 ± 18.194) for control group, (29.2 ± 13.826) for combination group and (35.93± 14.143) for indirect group. Mean and standard deviation of total dysphagia handicap scores **after 2 weeks** was (42.23 ± 17.011) for control group, (25.67± 10.634) for combination group and (32.6 ± 13.348) for indirect swallowing exercise group. Mean and standard deviation of total dysphagia handicap scores **after 3 weeks** was (41.03 ± 16.446) for control group, (20.2± 8.816) for combination group and (29.73± 12.446) for indirect swallowing exercise group. There were statistically significant differences between control and combination swallowing exercise group at 2nd week (t=2.226, p value =0.030) and at 3rd week (t=3.084, p value = 0.003) but there were no statistical significance differences between control and indirect group and also between combination and indirect group at all weeks before and after interventions. ANOVA

value was F (df: 2.000) = 3.407. P value was 0.038. P-value≤ 0.05 is significant at two tailed.

Section III:

Table (7) describes that, there was positive correlations between age and duration of dysphagia and positive correlation between duration of head and neck cancer and duration of dysphagia. Moreover, there was positive correlations between swallowing disturbances and related physical, functional, and psychological problems.

Section I: Description of the study samples' demographic characteristics, and medical data related to head and neck cancer disease of the control and the two intervention groups.

Table (1): Frequency and percentage distribution of demographic characteristics among control and two intervention groups (n=90).

Variables	Control group (G1), n = 30		Intervention groups: Combination Swallowing Exercises (G2), n = 30		Intervention groups: Indirect Swallowing Exercises (G3), n = 30		X^2 Test	p-value
	No.	%	No.	%	No.	%		
Age (years):								
30- < 40	4	13.3%	3	10.0%	3	10.0%	0.850	0.932
40- < 50	7	23.3%	10	33.3%	9	30.0%		
50- ≤ 60	19	63.4%	17	56.7%	18	60.0%		
Mean ± SD	49.43 ± 6.399		49.03±5.828		49.50±6.431			
Gender:								
- Male	17	56.7%	19	63.3%	18	60.0%	0.278	0.870
- Female	13	43.3%	11	36.7%	12	40.0%		
Marital status								
- Married	22	73.3%	24	80.0%	23	76.7%		
- Divorced	5	16.7%	3	10.0%	4	13.3%	0.587	0.965
- Single	3	10.0%	3	10.0%	3	10.0%		
Residence:								
- Urban	17	56.7%	18	60.0%	16	53.3%	0.271	0.873
- Rural	13	43.3%	12	40.0%	14	46.7%		
Education Level:								
- Can read and write.	1	3.3%	1	3.3%	1	3.3%		
- Preparatory	2	6.7%	2	6.7%	1	3.3%	0.937	0.988
-Secondary	14	46.7%	12	40.0%	15	50.0%		
- University	13	43.3%	15	50.0%	13	43.3%		
Occupation:								
Employee	9	30.0%	12	40.0%	11	36.7%	0.923	0.921
House wife	11	36.7%	10	33.3%	9	30.0%		
Causal work	10	33.3%	8	26.7%	10	33.3%		
Smoking:								
- Yes	10	33.3%	7	23.3%	9	30.0%	1.023	0.600
- No	20	66.7%	23	76.7%	21	70.0%		

***P-value≤ 0.05 is significant at two tailed.**

Table (2): Frequency and percentage distribution of medical data among control and two intervention groups (n=90).

Variables	Control group (G1), n = 30		Intervention groups: Combination Swallowing Exercises (G2), n = 30		Intervention groups: Indirect Swallowing Exercises (G3), n = 30		X^2 Test	p-value
	No.	%	No.	%	No.	%		
Duration of head and neck cancer:								
- Less than 1 month.	2	6.7%	0	0.0%	2	6.7%	2.729	0.604
- 1- <5 months.	19	63.3%	23	76.7%	21	70.0%		
- 5 months <1 year.	9	30.0%	7	23.3%	7	23.3%		
Mean ± SD	3.30±1.878		2.67±1.647		2.87±1.737			
Duration of dysphagia:								
- Less than or equal 1 month.	13	43.3%	11	36.7%	13	43.3%	1.623	0.805
- More than 1 ≤ 3 months.	12	40.0%	15	50.0%	13	43.3%		
- More than 3 < 6 months.	5	16.7%	4	13.3%	4	13.3%		
Mean ± SD	2.17 ±1.177		1.87±0.937		1.93±0.048			
Family history of head and neck cancer:							0.300	0.861
- Yes	11	36.7%	9	30.0%	10	33.3%		
- No	19	63.3%	21	70.0%	20	66.7%		
Body Mass Index:							5.056	0.282
- Normal BMI:	12	40.0%	15	50.0%	14	46.7%		
- Below normal BMI:	5	16.7%	1	3.3%	1	3.3%		
- Above normal BMI:	13	43.3%	14	46.7%	15	50.0%		
Mean ± SD	24.77±4.477		24.57±3.298		24.67±2.857			
Recent weight loss:							0.775	0.679
- Yes:	23	76.7%	22	73.3%	20	66.7%		
- No:	7	23.3%	8	26.7%	10	33.3%		
Mean ± SD	1.97± 0.351		1.90±0.269		1.77±0.357			
Comorbid diseases:							2.462	0.991
- No	8	26.7%	9	30.0%	10	33.3%		
- Diabetes Mellitus.	10	33.3%	11	36.7%	10	33.3%		
- Hypertension and diabetes Mellitus	7	23.3%	6	20.0%	5	16.7%		
- Hypertension and cardiac diseases	3	10.0%	1	3.3%	3	10.0%		
- Renal disease	2	6.7%	3	10.0%	2	6.7%		

***P-value≤ 0.05 is significant at two tailed.**

Section II: Delineates hypothesis testing for being supported or not

Table (3) Frequency and categorical distribution of swallowing disturbance scale among control and two intervention groups (n=90).

Variables	Control group (G1), n = 30		Intervention groups: Combination Swallowing Exercises (G2), n = 30		Intervention groups: Indirect Swallowing Exercises (G3), n = 30		X^2 Test	p-value
	No.	%	No.	%	No.	%		
Swallowing disturbance before intervention:								
- Seldom.	7	23.3%	9	30.0%	6	20.0%	0.857	0.931
- Frequently.	15	50.0%	14	46.7%	16	53.3%		
- Very Frequently.	8	26.7%	7	23.3%	8	26.7%		
Swallowing disturbance at the end of 1st week:								
- Seldom.	7	23.3%	12	40.0%	8	26.7%	2.261	0.688
- Frequently.	15	50.0%	12	40.0%	14	46.7%		
- Very Frequently.	8	26.7%	6	20.0%	8	26.7%		
Swallowing disturbance at the end of 2nd week:								
- Seldom.	7	23.3%	17	56.7%	9	30.0%	9.404	0.05*
- Frequently.	13	43.3%	9	30.0%	15	50.0%		
- Very Frequently.	10	33.3%	4	13.3%	6	20.0%		
Swallowing disturbance at the end of 3rd week:								
- Seldom.	6	20.0%	17	56.7%	9	30.0%	9.909	0.042*
- Frequently.	15	50.0%	9	30.0%	15	50.0%		
- Very Frequently.	9	30.0%	4	13.3%	6	20.0%		

***P-value≤ 0.05 is significant at two tailed.**

Table (4) Frequency and categorical distribution of physical problems related to dysphagia handicap scale among control and two intervention groups (n=90).

Variables	Control group (G1), n = 30		Intervention groups: Combination Swallowing Exercises (G2), n = 30		Intervention groups: Indirect Swallowing Exercises (G3), n = 30		X^2 Test	p-value
	No.	%	No.	%	No.	%		
Physical problems related to dysphagia before intervention:								
- No:	7	23.3%	8	26.7%	6	20.0%	1.686	0.793
- Sometimes:	13	43.3%	16	53.3%	16	53.3%		
- Always:	10	33.3%	6	20.0%	8	26.7%		
Physical problems related to dysphagia at the end of 1st week:								
- No:	7	23.3%	12	40.0%	8	26.7%	2.261	0.688
- Sometimes:	15	50.0%	12	40.0%	14	46.7%		
- Always:	8	26.7%	6	20.0%	8	26.7%		
Physical problems related to dysphagia at the end of 2nd week:								
No:	6	20.0%	16	53.3%	9	30.0%	9.811	0.044*
Sometimes:	13	43.3%	10	33.3%	15	50.0%		
Always:	11	36.7%	4	13.3%	6	20.0%		
Physical problems related to dysphagia at the end of 3rd week -								
No:	5	16.7%	17	56.7%	8	26.7%	11.85	0.019*
- Sometimes:	16	53.3%	9	30.0%	15	50.0%		
- Always:	9	30.0%	4	13.3%	7	23.3%		

***P-value≤ 0.05 is significant at two tailed.**

Table (5) Frequency and categorical distribution of functional problems related to dysphagia handicap scale among control and two intervention groups (n=90).

Variables	Control group (G1), n = 30		Intervention groups: Combination Swallowing Exercises (G2), n = 30		Intervention groups: Indirect Swallowing Exercises (G3), n = 30		X^2 Test	p-value
	No.	%	No.	%	No.	%		
Functional problems related to dysphagia before intervention:								
- No:	8	26.7%	7	23.3%	6	20.0%	0.699	0.952
- Sometimes:	12	40.0%	14	46.7%	15	50.0%		
- Always:	10	33.3%	9	30.0%	9	30.0%		
Functional problems related to dysphagia at the end of 1st week:								
- No:	9	30.0%	11	36.7%	7	23.3%	1.626	0.804
- Sometimes:	14	46.7%	11	36.7%26.7%	15	50.0%		
- Always:	7	23.3%	8		8	26.7%		
Functional problems related to dysphagia at the end of 2nd week:								
- No:	6	20.0%	13	43.3%	9	30.0%	4.294	0.368
- Sometimes:	16	53.3%	13	43.3%	15	50.0%		
- Always:	8	26.7%	4	13.4%	6	20.0%		
Functional problems related to dysphagia at the end of 3rdweek:								
- No:	6	20.0%	17	53.3%	8	26.7%	10.39	0.034*
- Sometimes:	15	50.0%	9	30.0%	15	50.0%		
- Always:	9	30.0%	4	16.7%	7	23.3%		

***P-value≤ 0.05 is significant at two tailed.**

Table (6) Frequency and categorical distribution of psychological problems related to dysphagia handicap scale among control and two intervention groups (n=90).

Variables	Control group (G1), n = 30		Intervention groups: Combination Swallowing Exercises (G2), n = 30		Intervention groups: Indirect Swallowing Exercises (G3), n = 30		X^2 Test	p-value
	No.	%	No.	%	No.	%		
Psychological problems related to dysphagia before intervention:								
- No:	9	30.0%	9	30.0%	8	26.7%	0.549	0.969
- Sometimes:	13	43.3%	15	50.0%	15	50.0%		
- Always:	8	26.7%	6	20.0%	7	23.3%		
Psychological problems related to dysphagia at the end of 1st week:								
- No:	9	30.0%	11	36.7%	8	26.7%	1.263	0.868
- Sometimes:	12	40.0%	13	43.3%	14	46.7%		
- Always:	9	30.0%	6	20.0%	8	26.7%		
Psychological problems related to dysphagia at the end of 2nd week:								
- No:	8	26.7%	12	40.0%	9	30.0%	3.039	0.551
- Sometimes:	13	43.3%	14	46.7%	15	50.0%		
- Always:	9	30.0%	4	13.3%	6	20.0%		
Psychological problems related to dysphagia at the end of 3rd week:								
- No:	7	23.3%	16	53.3%	8	26.7%	8.281	0.082
- Sometimes:	13	43.3%	10	33.3%	15	50.0%		
- Always:	10	33.3%	4	13.3%	7	23.3%		

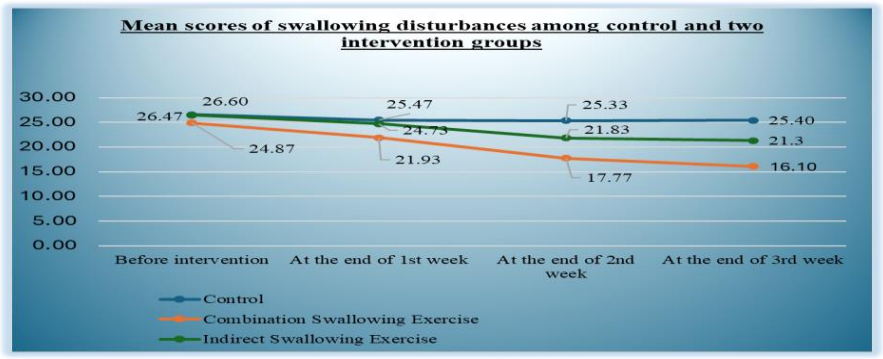

Figure (1) Comparison of mean scores of swallowing disturbances among control and two intervention groups at the end of the 1st , 2nd , and 3rd week (n=90).

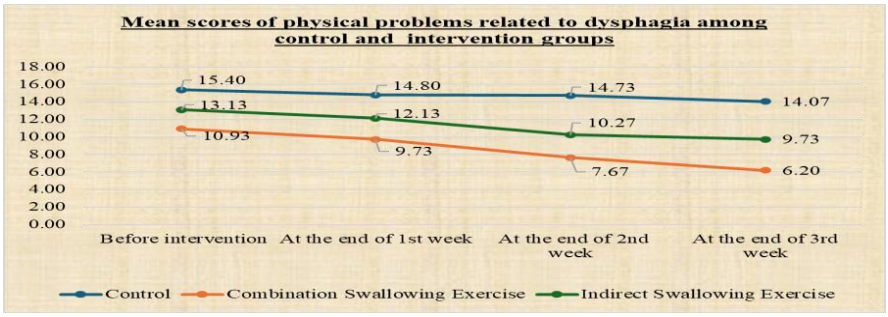

Figure (2) comparison of mean scores of physical problems related to dysphagia among control and two intervention groups at the end of the 1st , 2nd , and 3rd week (n=90).

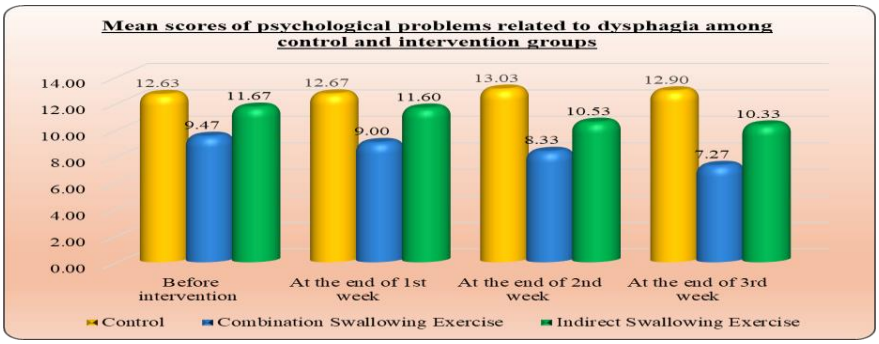

Figure (3) comparison of mean scores of Functional problems related to dysphagia among control and two intervention groups at the end of the 1st , 2nd , and 3rd week (n=90).

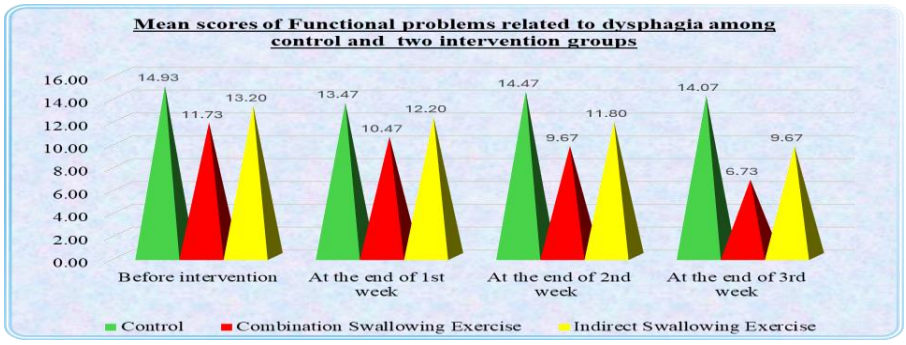

Figure (4) comparison of mean scores of psychological problems related to dysphagia among control and two intervention groups at the end of the 1st, 2nd, and 3rd week (n=90).

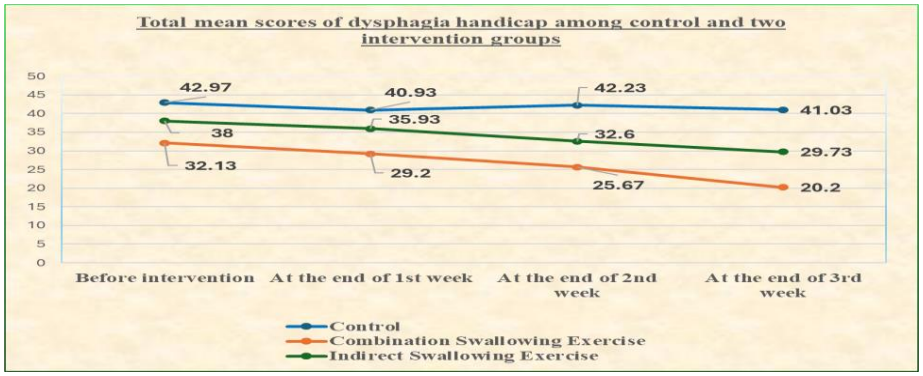

Figure (5) Comparison of total mean scores of dysphagia handicaps among control and two intervention groups at the end of the 1st , 2nd , and 3rd week (n=90).

Section III:

Table (7): Correlation between selected demographic and medical data with duration of dysphagia, and dimensions of dysphagia handicaps among the control and the intervention groups (n=90)

Selected Items	Age	Duration of head and neck cancer	BMI	Swallowing disturbances
Duration of Dysphagia	r: 0.409 P: 0.000*	r: 0.291 P: 0.005*	r: 0.185 P: 0.080	r: 0.157 P: 0.140
Physical problem related to swallowing disturbances	r: 0.071 P: 0.505	r: 0.012 P: 0.910	r: 0.089 P: 0.403	r: 0.906 P: 0.000*
Functional problem related to swallowing disturbances	r: 0.087 P: 0.413	r: 0.041 P: 0.704	r: 0.065 P: 0.545	r: 0.867 P: 0.000*
Psychological problem related to swallowing disturbances	r: 0.026 P: 0.807	r: 0.016 P: 0.883	r: 0.005 P: 0.963	r: 0.909 P: 0.000*

***P-value≤ 0.05 is significant at two tailed.**

Discussion

Dysphagia, is a common and debilitating side effect experienced by patients undergoing radiotherapy for HNC. This condition can substantially result in malnutrition, dehydration and aspiration. In a review, aspiration rates of 30–62% were reported. Recent studies have suggested that implementing swallowing exercises during or after radiotherapy can improve these issues and enhance patient outcomes (**Nutting et al., 2023**). Therefore, the aim of the current study was to investigate the effect of combination versus indirect swallowing exercises on dysphagia among patients with head and neck cancer receiving radiotherapy. The following discussion will be presented in three sections, **firstly,** demographic and medical section, **secondly**, hypotheses argument, **thirdly**, presents the additional findings.

First section:

Commencing with the demographic characteristics of the participants, the findings of the current study revealed that there was no statistically significant difference between the study and control groups indicating sample homogeneity. Considering a more detailed view of the demographic data of the current study, it was found that more than half to two thirds of the control and study groups were male, with an age range of fifty to less than or equal to sixty years with mean of age (49.32) and residing in urban regions.**(J.-O. Park et al., 2022; Shrestha et al., 2023)** emphasized that the higher incidence of HNC is among males than females, attributed to the greater prevalence of established risk factors such as tobacco use and alcohol consumption among males.

A study done by **(Siegel et al., 2021)** agreed that males are more than twice as likely to develop HNC as females, also are more commonly diagnosed in adults over the age of fifty than in younger people. **(Kouka et al., 2023)** contradicting the current study findings and stated that patients with HNC are nearly 60% over 60 years old. Of these, approximately 70% are over 65 years and 50% over 70 years old. This inconsistency could be explained by the age limit of sixty years in the current study inclusion criteria, which was set to exclude dysphagia

difficulties that might be occur resulting from the aging process.

Moreover, the majority of the participants were married and nonsmokers. The present study's findings appear to be inconsistent with those of **(Mohammed et al., 2022),** who reported a significantly higher prevalence of smoking among their sample population. This discrepancy may be attributed to the differing methodologies employed, as the current study focused solely on the current smoking status of participants, whereas the other one assessed the smoking history. Nearly more than one third of the control and study groups were housewives and employees. As for residence, more than half of the studied sample lived in urban region. Pertaining to the level of education the current study revealed that almost half of the studied sample had secondary and university education, which is matched to some extent with (**Mohammed et al., 2022)** study findings who reported that two thirds of the studied sample' were educated. This result contradicted with a study done by **Conway et al., (2015),** who found that low education was associated with an increased risk of head and neck cancer. This result may be interpreted in the light of the fact that more than half of the current study sample resides in urban areas where there is emphasis on education and a greater availability of resources and universities.

The majority of the control, and study groups had HNC from one to less than five months with no family history. According to duration of dysphagia approximately more than one third to half of the control and study groups had dysphagia from more than 1 to less than or equal 3 months, this could be attributed to methodological concern related to the inclusion criteria of the current study.

The observed recent weight loss among the majority of the current study participants is in harmony with **Lee et al., (2019)** who highlighted the significant weight loss experienced by HNC patients during and after radiotherapy. The current study findings demonstrated a significant proportion of the sample experienced various degrees of the dysphagia, which is likely contribute to this weight loss. With reference to comorbid diseases about one third of the participants had diabetes mellitus. It is worth noting that there was no statistically significant difference among the study groups in terms of medical data demonstrating the homogeneity of the control and study groups.

Second Section:

When comparing the study and control groups based on swallowing disturbance scores, it is clear that the three groups experienced frequent swallowing disturbances prior to and one week after intervention, confirming that there is no differences at all between the study and control groups. Nevertheless, after two and three weeks of applying the swallowing exercises by the study groups, statistically significant differences were recorded between the control and combination swallowing exercise groups, likewise between control and indirect group at the third week of intervention. These findings demonstrated that the study groups exhibited improvements in swallowing disturbances. Similarly, statistical analysis revealed significant benefits for the combination group compared to the indirect group during the second and third weeks of intervention. **Lending support to the first and third research hypotheses**. The researchers claimed this improvement in swallowing function in the study groups to the fact that swallowing exercises strengthen and enhance synchronization between nerves and muscles involved in the swallowing process.

Zedan et al., (2023) were in line with these findings and reported an improvement in swallowing function between study and control groups after performing swallowing exercises benefiting study group and this may be related to that Masako and supraglottic exercises strengthen the pharyngeal phase initiation and enhance swallowing function. Furthermore, swallowing training, which mostly includes training of the oral muscle group, tongue, and esophagus improve oral intake and swallowing without difficulty, in contrast to control group.

Speaking the same language, **Yasaroglu & Demir, (2023)** stated that swallowing exercises can strengthen pharyngeal wall contractions, which assist in eating and facilitate food passing through the upper esophageal sphincter into the esophagus; moreover, strengthening airway muscles leads to bringing the vocal folds together prior to and during swallowing, creating a mechanical barrier to aspirated material that may cause chocking. Swallowing exercises as mentioned by **Baudelet et al., (2024)** can lead to less muscle atrophy and an improved dysphagia with less aspiration, less feeding tube dependency and less hospitalization post-treatment. This is also supported by a study conducted by **Mizuhashi & Koide, (2020),** who reported that swallowing

exercise can stimulate the muscles around the salivary gland and the vagus nerve, thus promoting salivary secretion. This helps to decrease the thickness of the saliva and dryness of the mouth, which improves oral function.

Conversely, **Peng et al., (2015)** observed no significant differences between pre-and post-treatment swallowing function in patients who perform swallowing exercises, whereas patients who did not adhere to them showed a tendency toward worse swallowing function. This discrepancy can be ascribed to the degree of patient adherence to the exercise regimen and other methodological variations. This is confirmed by **Hajdú et al., (2022)** perspective, who emphasized that the way the exercises are given, the service-delivery mode, has a significant effect on patients' adherence and consequently the outcome.

To shed the light on the dysphagia handicapping-related domains which reflect patient's self-perception of physical, functional and emotional changes in quality of life due to dysphagia, it was critical to thoroughly address the physical, functional and emotional aspects of dysphagia.

Concerning physical problems related to dysphagia, there was no statistically significant difference among the control, indirect and combination groups prior to and after one week of applying swallowing exercises. While statistically significant differences were observed in the mean score of physical problems related to dysphagia, between control and combination swallowing exercise groups at the second and third week also between control and indirect swallowing exercises groups only at the third week of intervention. Moreover, no statistically significance differences were noted between combination and indirect swallowing exercise groups. The researchers suggested that the observed improvement in physical problems related to dysphagia may be attributed to the swallowing exercises' ability to enhance the coordinated movement of the larynx, hyoid bone, and pharynx, thereby facilitating swallowing. Further, these exercises could potentially reduce airway obstruction during pharyngeal swallowing. This coincide with **Gomah Yousef et al., (2020)** who declared that swallowing exercises has significant positive effect on severity of dysphagia and improvement in swallowing ability among patients with cerebrovascular stroke.

In relation to the functional domain of dysphagia initially, there was no statistically significant difference among the three groups before and after one and two weeks of applying swallowing exercises as well as between combination and indirect swallowing exercise group during any of the assessment points. While later at the third week, statistically significant differences were recorded in the mean score of functional problems related to dysphagia between control, combination and indirect swallowing exercises groups. A clinical trial was performed by **Kumar et al., (2015)** on dysphagia preventive exercises agreed with the current study as they shown that in exercise arm, the patients were able to chew more variety of food items leading to a feeling of satisfaction and better self-esteem. Additional, swallowing time was much better in these patients and they were less dependent on alternative ways of feeding.

Denoting to the psychological domain of dysphagia, it is noteworthy that, statistically significant differences were observed of psychological problems related to dysphagia only between the control and combination swallowing exercise groups at the third week of intervention. While, no statistically significance differences were noted between control and indirect swallowing exercise groups or between the combination and indirect swallowing exercise groups during the rest of the assessment points. In fact, the researchers find these results logical; as those patients might need more time to resolve their emotional problems related to dysphagia. **Petersson et al., (2023)** results were partially in a harmony with the current study as their intervention group demonstrated improvements from baseline results during the follow-up at 8 weeks, with statistically significant improvements in the emotional and functional domain.

Overall, the dysphagia handicapping score were significantly lower in the combination swallowing exercise group at second and third-week follow-up. This indicates improvement in the physical, functional and emotional domains of quality of life during follow-up at week two and three, most likely due to the positive impact of combination swallowing exercise on dysphagia. Nevertheless, no statistically significance differences were documented either between control and indirect groups or between combination and indirect groups throughout the entire assessment points. **Thus, the second hypothesis is partially supported and the fourth**

one is not supported. A study done by **Kumar et al., (2015)** confirming the current findings and showed statistically better quality of life in dysphagia preventive exercise arm as compared to the standard treatment arm.

Banda et al., (2021) in their systematic review contradicting the current findings and concluded that swallowing exercises had non-significant effects on risk of aspiration and all domains of QoL. On the same wavelength, **Patterson & Lawton, (2023)** reported that swallowing exercises have largely been used in clinical practice; yet, the potential benefit of implementing these exercises prior to and during cancer treatment remains equivocal. The researchers suggest that, the observed discrepancy may be related to methodological variation as the timing and frequency of the exercise sessions, follow-up periods, and adherence rates.

In this context, **Hajdú et al., (2022)** emphasized that early initiated exercises target the swallowing structures are assumed to counter the effect of reduced spontaneous swallowing, **Patterson & Lawton, (2023)** added, early intervention may have the potential to improve treatment response and quality of life. Notably, the participants in the current study were newly diagnosed with head and neck cancer, undergoing their initial course of radiotherapy and enrolled during the first week of hospitalization. Additionally, the present study incorporated key factors important to adherence to intervention exercises, including personalized instruction and supervision by the researchers, clear exercise regimen, instructional flyers, videos, and follow-up phone calls.

Several factors might contribute to the positive outcome of the swallowing exercise in the current study. The literatures showed that higher adherence rates can be accomplished by limiting the exercises to only two different types, and the current study adopted this approach where the participants in the two experimental groups requested to perform only two exercises. Equally important, the intervention period in the present study limited to the first 4 weeks of radiotherapy, considering the well-documented peak of acute toxicities during the fifth week. The goal was to strengthen the patients' swallowing ability , prior to the occurrence of the adverse effects **(Essery et al., 2017; Baudelet et al., 2023).**

Concerning, lingual range of motion exercises **Park et al., (2020)** reported that they can increase lingual strength in healthy individuals and improve swallowing function in abnormal populations. Evidences supports the use of lingual exercises to improve tongue strength and coordination, which are essential for effective swallowing (**Lin et al., 2022**). Jaw exercise (JE) is commonly used to improve the swallowing function in dysphagia patients by strengthens the suprahyoid muscles, which are the agonistic swallowing muscles. Moreover, literature suggested that when dysphagia patients performed the JE for 4 weeks, it improved hyoid bone movement and opening of the upper esophageal sphincter. Nevertheless, the clinical effects of lingual and JE remain unclear **(Patk et al., 2019 ; Choi et al., 2020).**

Barot et al., (2023) reported that the Masako and supraglottic maneuvers improve the function of pharynx musculature also improves the constriction of the pharynx and airway obstruction during pharyngeal swallowing. Furthermore, Masako Maneuver improves tongue muscle strength, activates the central pattern like swallowing reflex, suprahyoid muscle activation, and improves swallowing coordination to protect the airway. Coughing episodes after eating are also reduced. Thus, Masako and supraglottic exercises may targets the swallowing musculature directly, accordingly, it may be more beneficial in improving swallowing function on top of indirect exercises.

Third Section:

This section focused on the additional findings that might bring to light the correlation between significant study variables. Positive correlations were observed between duration of dysphagia and age as well as duration of HNC. Moreover, there were positive correlations between swallowing disturbances and related physical, functional, and psychological problems that were supported by the previous findings.

Conclusion

Statistically significant differences were recorded between the control and combination swallowing exercise groups at the second week of intervention, likewise between control and indirect group at the third week of intervention. These findings demonstrated that the study groups exhibited improvements in swallowing disturbances. Similarly, statistical analysis revealed significant benefits for the combination group compared to the indirect group during the second and third weeks of intervention. **Lending**

support to the first and third research hypotheses.

Recommendations

Develop continuing training program for nurses who work in the oncology department about the assessment of dysphagia, and how to apply swallowing exercises to reduce intensity of dysphagia for patients had head and neck cancer.

Develop a training program for nurses about: swallowing anatomy and physiology, swallowing process, effect of radiotherapy on swallowing, manifestation of dysphagia, and the nursing role in managing patients with dysphagia.

A further study should be conducted on a larger probability sample from different geographical areas in Egypt to generalize the findings.

A Further longitudinal study to evaluate the effect of different types of swallowing exercises on dysphagia.

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