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Evaluation of Swallowing Related Measures in Different Head and Neck Postures in Healthy Young and Older Adults

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EVALUATION OF SWALLOWING RELATED MEASURES IN DIFFERENT HEAD AND NECK POSTURES IN HEALTHY YOUNG AND OLDER ADULTS

A thesis submitted in partial fulfillment of

the requirements for the degree of

MASTER OF SCIENCE

in

SPEECH-LANGUAGE PATHOLOGY

by

Mabell Vargas

2022

To: Dean Ora Strickland
College of Nursing and Health Science

This thesis, written by Mabell Vargas, and entitled Evaluation of Swallowing Related Measures in Different Head and Neck Postures in Healthy Young and Older Adults, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this thesis and recommend that it be approved.

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Alliete Alfano

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Balaji Rangarathnam

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Inae Caroline Gadotti, Co Major Professor

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Angela Medina, Co Major Professor

Date of Defense: June 27, 2022

The thesis of Mabell Vargas is approved.

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Dean Ora Stricklan
College of Nursing and Health Sciences

_____
Andrés G. Gil
Vice President for Research and Economic Development
and Dean of the University Graduate School

Florida International University, 2022

DEDICATION

I dedicated this thesis to God. The one that is been my guidance, strength, protection in this journey.

To my husband who taught me the importance of never give up on what I want and the one that is been my side in this entire journey.

To my parents, who have been my source of inspiration and who continually provide their moral, spiritual, and emotional support.

To my sisters, relatives, mentor, friends, and family who shared their words and advice and encouragement to finish this study.

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Thank you Dr. Rangarathnam because despite the distance you have been willing to help me at all the times. Thanks to Dr. Gadotti for teaching me a lot of thinks related to physical therapy. Thank you for your willingness throughout this process.

Thank you, Dr. Medina, for all your advice, for being an excellent teacher and for being an inspiration for my professional career.

Thank you Dr. Alfano, for being one of my first teachers and being a source of motivation in my career. Thank you for all your advice in this process.

I would also like thanks to all the to all the members of this investigation who made this process a reality. Thank you, Ana Lowe, Edward Castillo, Melanie Moore, Alex Shwin, Danielle Yost, Katherine Mazza, Adrianna Castro, and Bethany Clubb.

ABSTRACT OF THE THESIS

EVALUATION OF SWALLOWING RELATED MEASURES IN DIFFERENT HEAD AND NECK POSTURES IN HEALTHY YOUNT AND OLDER ADULTS

by

Mabell Vargas

Florida International University, 2022

Miami, Florida

Professors Inae Gadotti, Co Major Professor

Professor Angela Medina, Co Major Professor

Objectives*:* To evaluate swallowing related measures (oral transit time and number of swallows, tongue force and lip force) in natural head posture (NHP) and in a deliberate maximum but comfortable forward head posture (FHP) in healthy young and older adults. Methods*:* Participants consisted of 19 healthy young and 17 healthy old. They were asked to ingest 2 different liquid consistency to measure the time they take to swallow and the number of swallows. The maximum tongue and lip force was measured with the IOPI device for 3 seconds and repeated 3 times. Results*:* No differences of swallowing related measures were found between the two different head and neck postures. Furthermore, no differences were found between age groups.

Discussion*:* The results suggest that the participant sample show similar swallowing function regardless of posture condition and that there are no differences between age groups. This study can guide future multidisciplinary research evaluating young adults and elderly adults over the age of 75 with a large sample size.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

FHP	Forward Head Posture
NHP	Natural Head Posture
IOPI	Iowa Oral Performance Instrument

CHAPTER I

REVIEW OF THE LITERATURE

Introduction

Swallowing is a critical process for enabling life, allowing food and fluid to be ingested safely and efficiently. The passage of food involves the coordination of movements of muscles along the oral cavity, larynx, and esophagus. The physiology of a normal swallow is commonly described in four stages: oral preparatory stage, the oral stage, the pharyngeal stage, and the esophageal stage (Logemann, 1998).

Any structural, physiological, or neurological disturbance in swallowing may cause dysphagia (Alghadir et al., 2017). There is evidence to suggest that postural aspects can contribute to the swallowing process (Alghadir et al., 2017; Papadopoulou et al., 2013). Specifically, there is evidence that body posture may influence swallowing performance, including bolus transport and muscle activity during swallowing (Inagaki et al., 2008). Lund et al. (1970) demonstrated that there was hyperactivity of the digastric muscle in an electromyographic (EMG) when participants were positioned in an upright position than in the supine position.

Despite strong associations between swallowing and posture, systematic investigations of the two have not been completed in the literature thus far – especially in healthy aging adults. This knowledge is important from both a basic science perspective of objective understanding of the relationship, as well as utilizing it appropriately in clinical rehabilitation.

The overarching goal of the proposed research was to investigate swallowing related measures (oral transit time and number of swallows, tongue force and lip force) in natural head posture (NHP) and in a deliberate maximum but comfortable forward head posture (FHP) in

healthy young and older adults. The study is significant in providing the first data-based outcomes for the relationship between the two different head positions NHP and FHP and swallowing. The study utilized the interdisciplinary scientific knowledge of speech-language pathology and physical therapy.

Swallowing in older adults

Swallowing physiology changes as a person age and is marked notably by a reduction in physiological effort (e.g., reduced lingua-palatal and pharyngeal pressures) (Tamine et al., 2010). Age- related increase in dysphagia has been attributed to a diminished physiological reserve and increased prevalence of disease (Clark & Solomon, 2012). Research suggests that changes in swallowing should be expected due to aging. The elderly population is most associated with oropharyngeal dysphagia (Shaker, 2006). Characteristics of aging include atrophy, dystrophy, and edema, which are precursors to gross morphological changes such as decreased elasticity and demyelinization (Chodzko-Zajko & Ringel, 1987).

Behavioral slowing of motor response is characterized by a decline in reaction time, the time necessary for transmission of sensory information, decision making, and motor execution (Gleeson, 1999). Cognitive decline in normal elderly individuals is associated with decreased psychomotor speed; slowing of central cognitive processes; and decline in somatosensory, auditory, and visual sensory acuity (Salthouse, 1985) – all of which are critical processes involved in deglutition.

Elderly individuals tend to need more time to consume food and the efficiency of the muscles involved in swallowing is reduced and more fatigable. An increased prevalence of aspiration and pneumonia is associated with fatigue of the infrahyoid and suprahyoid muscle groups with repetitive swallowing during meals (Hiramatsu et al., 2015). Physiological

swallowing functions deteriorate even in healthy dentate elderly individuals. This deterioration may be explained primarily by the influence of aging on swallowing (Yoshikawa et al., 2005).

Head and Neck posture in swallowing

Extant research has documented associations between posture and swallowing (Papadopoulou et al., 2013). These reports have documented a relationship between healthy swallowing and different postures, as well as the use of postural changes in facilitating bolus flow in individuals with dysphagia (Rasley et al., 1993).

Research in patient populations suggests that head rotation causes the bolus to lateralize away from the direction of head rotation (Logemann et al., 1989). Head rotation has also been reported to facilitate the opening of the upper esophageal sphincter (UES) by posturally providing external pull on the cricopharyngeus muscle (Ohmae et al., 1998). It has been observed that anatomical changes resulting from head rotation and chin tuck posture improve bolus flow and swallowing efficiency, however, results are not uniform across populations (Balou et al., 2014).

Moller and Nishiyama (1971) analyzed electromyogram (EMG) activities of the lateral pterygoid and digastric muscles during swallowing of saliva. They documented that these muscles started firing earlier (30–100 ms) in the 45°inclined and supine position than in the upright position, suggesting that the supine posture shortens the oral phase of swallowing. Furthermore, Inagaki et al. (2007) reported that postural changes (from the natural upright to the inclined and supine positions) during swallowing shorten the duration of the oral phase as defined through electromyographic data.

STATEMENT OF NEED

While reports of associations between swallowing and posture are emerging, systematic investigations of the two and their relationship to aging have not been completed in the literature thus far. This knowledge is important from both a basic science perspective of objective understanding of the relationship, as well as utilizing it appropriately in clinical rehabilitation. This study will give useful information for researchers and clinicians regarding possible association of swallowing related alterations with altered head and neck posture in different age groups. The knowledge obtained from this study will help treat future patients with swallowing impairments (i.e., dysphagia) and related head and neck posture alterations.

The experimental questions being addressed in the current study are: 1) Does forward head posture (FHP) influence the swallowing related measurements in healthy young and older adults by evaluating oral transit time, number of swallows and tongue and lip force 2) How do swallowing related measures compare between healthy young and older adults.

To investigate these questions, an inter-disciplinary research design utilizing principles of speech-language pathology and physical therapy was utilized. The questions were investigated by evaluating oral transit time and number of swallows, tongue force and lip force in natural head posture (NHP) and in a deliberate maximum but comfortable FHP in a standardized sitting position. This was measured in two groups: healthy young and older adults. Differences of swallow related measures were compared between the two posture conditions (NHP and deliberate FHP) for both groups.

The proposed research utilizes a research design driven by a solid foundation of the oropharyngeal physiology that provides an interdisciplinary perspective of rehabilitation that has

not been investigated before. This research also pertains to use both subjective and objective measures that aid in direct translation of research findings to rehabilitation of swallowing and postural impairments.

Specific Aim and Hypothesis

Specific Aim 1: To determine the effect of a deliberate forward head posture (FHP) on swallowing related measurements. ***Hypothesis 1:*** Participants with a deliberate FHP will present more difficulty when measured the oral transit time and number of swallows. They will also present less force in tongue and lip in FHP compared to normal head posture (NHP).

Specific Aim 2: To examine the differences related to swallowing related measures and head and neck posture between healthy young and older adults. ***Hypothesis 2:*** Healthy young and older adults will show differences related to swallowing related measures and head and neck measures. It is expected that older adults will present more alterations of head and neck posture and swallow related measures.

CHAPTER II

METHODS

All study procedures were carried out following an approval from the Institutional Review Board (IRB) at Florida International University (IRB-21-0276-AM01).

Participants: Forty healthy individuals were recruited for the study. Participants consisted of 19 younger adults (Group 1, 18-50 years) and 17 older adults (Group 2, 60-75 years). Males and females of all races and ethnicities, and socio-economic statuses, meeting the inclusionary criteria were in the study.

The inclusion Criteria were participants ability to speak and read English, ability to give consent form, young adults between 18 and 50 years old and older adults between 59 and 77years old. The exclusion Criteria were history of surgery or trauma of the neck, frequent head and neck pain, neurological or systemic disorders and history of known swallowing impairment.

The data collection took place in the Human Performance Lab, a part of the Collaborative Advanced Rehabilitation/Research and Education (CARE) center of the Nicole Wertheim College of Nursing and Health Sciences at FIU. The purpose and procedures of the study were explained to the participants before the study and if they agreed to participate, they signed an informed consent form. Prior to the study, participants were asked questions related to their demographics and medical history. During the study, participants completed swallowing and craniocervical related procedures in two different stations. Participants completed each station in the order described below.

PROCEDURES

Clinical swallow related measures

The swallowing related measures (oral transit time and number of swallows, tongue force and lip force) measured in natural head posture (NHP) and in a deliberate maximum but comfortable forward head posture (FHP) in a standardized sitting position (Gadotti et al, 2020). The standardized sitting position consisted of back resting on the back of a chair, with both feet on the ground and hands placed on top of the participant's legs.

For the clinical measures of swallow (oral transit time and number of swallows), two different liquid consistencies were ingested by each participant. The number of swallows for each liquid consistency and the total duration was measured. The participants were asked to ingest 100ml of two different food consistencies (water and honey thick). In a standardized sitting position (both feet on the ground, hands on lap, with back to the back of the chair), participants swallowed each consistency in a natural head posture (NHP) and in a deliberate forward head posture (FHP). The order for posture condition and liquid consistency was randomized. This consisted of randomly placing the order in which the participants were going to take each consistency as well as the position they had to take. The time it takes for each participant to pass the bolus (100ml of each consistency) from the mouth to the oropharynx (throat) was measured using a stopwatch timer. The number of swallows was measured by palpating the participants hyoid bone and counting the number of times the larynx elevates

(Figure 1). Participants ingested 100ml of each of the two consistencies twice for each of the head positions (NHP and deliberate FHP).

Figure 1. Swallowing measures.

Lip and tongue force measure procedure

Tongue and lip maximum force were measured with the Iowa Oral Performance Instrument - IOPI (Northwest, Co., LLC, Carnation, WA, EEUU). The IOPI device is commonly used to measure tongue force because it is easy to use, it is portable, and has a silicon air-filled bulb which allows to measure isometric tongue pressure against the hard palate. The intra and inter-rater reliability of tongue force measurements using the IOPI device was reported to be good to excellent (ICC>0.75) (Adams et al, 2014).

For lip force, the bulb was placed inside the participant's cheek just lateral to the corner of the mouth. The subjects were asked to choose the side and always use the same side for all measurements of lip force the participant was asked to squeeze the bulb against the buccal surface of the teeth by pursing the lips as hard as possible (Figure 2 or 3). To measure the tongue

force, the bulb was placed against the hard palate, directly behind the alveolar ridge (Figure 3). Participants were instructed to use their tongue blade to press the bulb against their hard palate.

They were asked to keep their lips closed during all measurements but without reaching the dental occlusion, allowing the cable connected to the bulb to pass between the teeth. After the bulb is correctly placed for each position (was supervised by the researchers), the participants were instructed to squeeze the bulb as hard as possible for 3 seconds, 3 times. In each trial the participant had 30-second break in between. All trials were randomized for tongue/lip force and posture conditions. The lip and tongue force were acquired for each participant in NHP. The highest pressures, in kilopascals (kPa), was recorded for each trial and the highest-pressure across the three trials was selected as the maximum force measurement for each force measure.

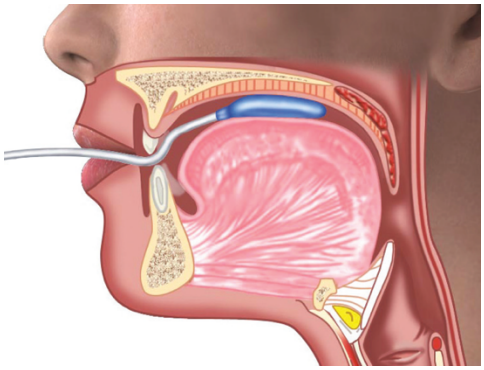

Figure 2. IOPI Bulb Placement to measure tongue force

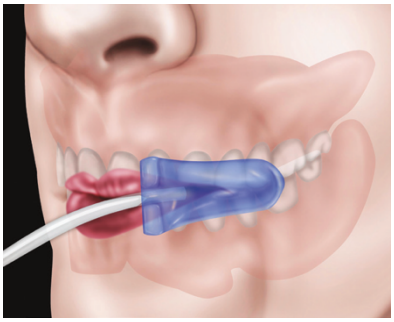

Figure 3. IOPI Bulb Placement to measure lip force

Training procedure

Consistency in standardized instruction was maintained by the researcher. Each evaluator was trained before starting the research. A script of each measurement was followed during the implementation of each assessment to ensure that procedures are followed. To keep the data consistent, a google doc was created with the purpose of adding all the data corresponding to each assessment appropriately.

DATA ANALYSIS

A descriptive analysis was performed on the demographic variables to describe the sample including sex, age, and health status.

ANOVA models were used to test differences of swallowing related measures (tongue force, lip force, number of swallows and swallow time) between the two posture conditions (NHP and deliberate FHP) for both age groups. A multivariate analysis was performed to estimate the relationship between swallowing related measures in healthy young an older adult.

The data were analyzed using the SPSS v.24 statistical program (IBM technologies).

CHAPTER V

RESULTS

The purpose of the study was to determine whether FHP influence the swallowing related measurements in healthy young and older adults by evaluating number of swallows, tongue and lip force and how do posture, number of swallows, tongue force, and lip force compare between healthy young and older adults. A total of 36 participants were considered for analyses. 19 younger adults and 17 older adults (Table 1).

Table 1. Subjects Characteristics.

Subjects Characteristics		
	Group 1 (Healthy Adults)	Group 2 (Older Adults)
Men	5	5
Women	14	12
Age Mean (SD)	25.94 (12.05)	66.17 (6.08)

To determine the effect of a deliberate forward head posture (FHP) on swallowing related measurements the data were analyzed to by calculating the number of swallows, swallow time, posture and age group using a multivariate measure ANOVA. The independent categorical variables were: 1) age group (younger and older). The swallowing related continues dependent variables were 1) number of swallows thin (NHP), 2) number of swallows honey (NHP), 3) number of swallows thin (NHP), 4) number of swallows honey (FHP), Swallow time thin (NHP),

5) swallow time honey (NHP), 6) swallow Time thin (FHP), 7) swallow time honey (FHP), 8) lip force (NHP), 9) lip force (FHP), 10) tongue force (NHP), 11) tongue force (FHP).

Multiple two-way ANOVA were performed to determine the effect of the deliberate FHP condition on swallowing related measures (number of swallows, time of swallow, tongue force, and lip force) when compared to a NHP, and to determine differences between healthy young and older adults. The two-way ANOVA revealed that there was not a statistically significant interaction between the head posture (NHP and FHP), number of swallows, the consistency and age group (Figures 1 and 2). Simple main effects analysis showed that posture condition did not have a statistically significant effect on swallowing related measures. Therefore, there was insufficient evidence to reject the null hypothesis that there is no effect of posture condition on swallowing and swallowing related measures.

To determine how number of swallows, tongue force, and lip force compare between healthy young and older adults the data were analyzed to by calculating the number of swallows, swallow time, posture and age group using a multivariate measure ANOVA as well.

Multiple two-way ANOVA were performed to determine the effect of swallowing related measures on healthy young and older adults. The two-way ANOVA revealed that there was not a statistically significant interaction between the head posture (NHP and FHP), number of swallows, the consistency and age group. Simple main effects analysis showed that age did not have a statistically significant effect on swallowing measures. Simple main effects analysis showed that age did not have a statistically significant effect on swallowing-related measures. Therefore, there was insufficient evidence to reject the null hypothesis that there is no effect of age on swallowing-related measures (See table 2 and appendix table 4, 5, 6 and 7).

Table 2. Mean and standard deviation (SD) for swallowing related measures by group and posture conditions

Swallowing related measures	Younger		Older	
	NHP	**Deliberate FHP**	**NHP**	**Deliberate FHP**
Clinical measures				
Time to swallow	M thin=11.02 M honey= 17.18 SD thin= 5.82 SD honey= 10.66	M thin=11.07 M honey=18.25 SD thin= 4.13 SD honey= 10.25	M thin=13.07 M honey= 11.01 SD thin= 4.35 SD honey= 5.82	M thin= 13.11 M honey= 22.1 SD thin= 4.80 SD honey= 79.53
Number of swallows	M thin= 6.21 M honey= 6.55 SD thin= 3.63 SD honey= 3.46	M thin=6.36 M honey= 6.65 SD thin= 2.98 SD honey= 2.73	M thin= 5.97 M honey= 6.58 SD thin= 2.35 SD honey= 2.71	M thin= 6.14 M honey= 6.5 SD thin= 2.22 SD honey= 2.82
Tongue				
Maximum Force (N)	M= 59.31 SD= 10.66	M= 61.31 SD= 9.05	M= 50.17 SD= 8.43	M= 51.05 SD= 7.77
Lip				
Maximum Force (N)	M=15.26 SD=9.98	M= 15.36 SD= 9.97	M= 16.82 SD= 7.97	M= 16.64 SD= 6.42

NHP: natural head posture; FHP: forward head posture; M: Mean; SD: Standard Deviation

CHAPTER VII

DISCUSSION

The purpose of the study was to determine whether a deliberate forward head posture influences swallowing related measurements (clinical measures of swallow, tongue/lip force) when compared to a natural head posture in healthy young and older adults.

It was hypothesized that participants with a deliberate FHP will present more difficulty when measured the oral transit time and number of swallows. It was also hypothesized that they will also present less tongue and lip force in FHP condition compared to natural head posture (NHP). However, the results showed that the FHP condition did not influence the swallowing related measures. Thus, our hypothesis was rejected.

It was also hypothesized that healthy young and older adults will show differences related to swallowing related measures and head and neck measures by presenting alterations of head and neck posture and swallow related measures. According to the results, no significant differences between healthy young and old were found. Thus, our hypothesis was rejected.

Even though postural measures were not significantly different in older adults, there is evidence to say that reflexes, postural control being affected due to sarcopenia and age-related changes to sensation, peripheral nerve supply, blood supply etc. Kim et al. (2020) used a nationally representative cohort study in Korea to investigate the association between the prevalence of sarcopenia and postural dysfunction. Sarcopenia is the progressive and generalized loss of skeletal muscle mass, strength and/or physical performance (Cruz-Jentoft et al., 2010).

The results of the study showed in their results that there is a significant relationship between sarcopenia and postural dysfunction (Kim et al., 2020).

Extant research has documented associations between posture and swallowing (Papadopoulou et al., 2013). These reports have documented a relationship between healthy swallowing and different postures, as well as the use of postural changes in facilitating bolus flow in individuals with dysphagia (Rasley et al., 1993). However, we did not find those to be significant in our study, possibly because of sample size, and age range of participants.

While the results of this study suggest that posture did not have a significant effect on swallowing-related measures more research is needed considering other factors for future research. Among the factors are the sample size. The small size if this study decreases the statistical power of the study. The imbalance between the age groups is part of the factors since the younger group was larger (n=19) than the older group (n=17). Other factor is the age range since we had certain parameters for the participant inclusion in the study (group 1= 18-55) and (group 2=59-77). Another factor is the use of subjective methods. While swallowing-related measures yielded quantitative data, the swallow time and number of swallows were clinically measured. The measures are susceptible to researcher error. Furthermore, participants head, and neck posture were classified subjectively using a visual assessment and only two categories were used (NHP and deliberate maximum but comfortable FHP). This may have not been sensitive enough to detect the participant's position.

The results of the study showed that the number of swallows is not significant regardless of the consistency, head posture and age group and it also showed that there's not significant difference between healthy young and old adults by evaluating the number of swallows, swallow time, tongue, and lip force. This is encouraging for older people because it suggests that the age

does not interfere with number of swallows, swallow time, tongue force and lip force regardless of the posture; however, more research should be applied for this population.

Limitations and implications for further research

One of the limitations in this study was the use of subjective measures. While swallowing-related measures yielded quantitative data, swallow time and number of swallows were clinically measured. These clinical measures are susceptible to researcher error. In future studies objective measures should be used to examine swallowing physiology.

Another limitation of the present study is the sample size in each age group. The small sample size decreases the prediction of the estimates and power of the study. This subsequently affects generalization of the results to the larger population. Future work should include larger sample sizes.

Despite the limitations, this study provides preliminary results for future studies. Future research can use this study as a guide to measure the interaction effects between age and posture in young healthy adults and elderly.

The development of research related to this topic will increase the importance of the Speech Language Pathologist understanding the importance of collaborate other professions. That will increase the knowledge of the patient's problem. In this case, this research collaborated with physical therapy, which gave us the starting point to relate how posture directly affects swallowing. This research should be the starting point for another research related to the subject to arise.

Summary and conclusions

This thesis presents results that suggest that the number of swallows is not significant regardless of the consistency, head posture and age group. Another important aspect of this thesis is that the results also revealed that the lip force is not significant regardless of head and neck posture or age group and that the tongue force is not significant regardless of head and neck posture or age group. These results should be further investigated with a larger and more diverse population. Future studies should also have a balanced population in order to allow for direct comparison between groups.

This thesis added to our knowledge of posture in swallowing related measures. The findings of this study support prior findings suggesting that age affects swallowing measures and posture affects swallowing measures. Finally, this thesis supported interprofessional collaboration between speech-language pathology and physical therapy disciplines.

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APPENDIX

FLORIDA INTERNATIONAL UNIVERSITY

Eligibility/Screening Form

Date: ____ /____ /_____

Name: _____

Sex: Female ____ **Male** ____

Age: _____ **Date of Birth:** ____ /____ /_____

Phone: _____

Email: _____

Do you have history of **surgery** in the head and neck region? Yes No

Do you have history of **trauma** in the head and neck region? Yes No

Do you have history or currently have **swallowing/tongue related difficulty** (coughing during eating/drinking, choking, feeling of something being stuck in the throat etc): Yes No

Do you have frequent **head and neck pain**? Yes Sometimes No
Frequency:
Pain level (0-10): Neck: Head:

Do you have history or currently have other pathology (**systemic, neurological**)? Yes No

If yes, please specify: _____

Are you on any **medication** for pain or musculoskeletal problems?: Yes No

Comments: _____

_____

FINAL DECISION:

Included: Younger group: _____ **Older group:** _____

Excluded _____

Consent form

ADULT CONSENT TO PARTICIPATE IN A RESEARCH STUDY
Evaluation of swallowing related measures in different head and neck postures in healthy young and older adults

SUMMARY INFORMATION

Things you should know about this study:

Purpose: The purpose of the study is to evaluate swallow related measures and craniocervical measures in a group of healthy young adults and in a group of healthy older adults.
Procedures: If you choose to participate, you will be asked to drink 2 types of liquid, perform a maximum tongue and lip force in 2 different head posture, have a photograph of your head and neck posture taken, and perform a test to measure the activation of your neck muscle.
Duration: This will take approximately 1 hour and 30 minutes.
Risks: Minimal risks may be associated with your participation in this study. You may experience some mild muscular discomfort during measurements.
Benefits: There are no direct benefits to you from this research.
Alternatives: There are no known alternatives available to you other than not taking part in this study.
Participation: Taking part in this research project is voluntary.

Please carefully read the entire document before agreeing to participate.

PURPOSE OF THE STUDY

You are being invited to participate in a study conducted by Drs. Inae Gadotti and Balaji Rangarathnam and their research teams in the Departments of Physical therapy and

Communication Sciences and Disorders at FIU. Through this study we hope to gain knowledge about how measures related to you neck and posture relate to your ability related to swallow function. The purpose of this study is to understand how these measures differ in older adults compared to younger adults. You are being asked to participate because you are a healthy adult without any swallowing or postural difficulties.

NUMBER OF STUDY PARTICIPANTS

If you decide to be in this study, you will be one of 40 people in this research study.

DURATION OF THE STUDY

Your participation will involve one visit, approximately 1 hour and 30 minutes in length.

PROCEDURES

If you agree to be in the study, we will ask you to do the following things:

1. You will be asked to drink 2 different liquid consistency (100ml each) in two different head and neck postures.
2. You will be asked to perform a maximum force of your tongue against the roof of your mouth and between lips for 3 seconds each in two different head and neck postures.

The study procedures will be carried out in the Florida International University MMC Campus.

RISKS AND/OR DISCOMFORTS

Minimal risks may be associated with your participation in this study. You may experience some mild muscular fatigue during measurements. You will be guided and monitored during the entire test. In addition, you can withdraw from the study anytime during the study.

BENEFITS

There will be no direct benefit to you from participating in this research study. The anticipated benefit of your participation in this study is determining age related changes that happen to our muscles and swallowing abilities. Indirectly, the knowledge obtained from this study will benefit the society when results are published.

ALTERNATIVES

There are no known alternatives available to you other than not taking part in this study.

CONFIDENTIALITY

The records of this study will be kept private and will be protected to the fullest extent provided by law. In any sort of report we might publish, we will not include any information that will make it possible to identify you. Research records will be stored securely, and only the researcher team will have access to the records. However, your records may be inspected by authorized University or other agents who will also keep the information confidential.

COMPENSATION & COSTS

You will not receive any compensation for your participation in this study. There are no costs to you for participating in this study.

RIGHT TO DECLINE OR WITHDRAW

Your participation in this study is voluntary. You are free to participate in the study or withdraw your consent at any time during the study. You will not lose any benefits if you decide not to participate or if you quit the study early. The investigator reserves the right to remove you without your consent at such time that he/she feels it is in the best interest.

RESEARCHER CONTACT INFORMATION

If you have any questions about the purpose, procedures, or any other issues relating to this research study you may contact Dr. Inae Gadotti at Florida International University, 305-348-0532 or igadotti@fiu.edu.

IRB CONTACT INFORMATION

If you would like to talk with someone about your rights of being a subject in this research study or about ethical issues with this research study, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

PARTICIPANT AGREEMENT

I have read the information in this consent form and agree to participate in this study. I have had a chance to ask any questions I have about this study, and they have been answered for me. I understand that I will be given a copy of this form for my records.

_____ _____

Signature of Participant Date

_____

Printed Name of Participant

_____ _____

Signature of Person Obtaining Consent Date

Table 4.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	NumberofSwallows_Thin_NaturalH	.517[a]	1	.517	.056	.814	.002	.056	.056
	NumberofSwallows_Thin_ForwardH	.440[b]	1	.440	.063	.804	.002	.063	.057
Intercept	NumberofSwallows_Thin_NaturalH	1331.294	1	1331.294	144.432	<.001	.809	144.432	1.000
	NumberofSwallows_Thin_ForwardH	1405.384	1	1405.384	200.094	<.001	.855	200.094	1.000
Age_Group	NumberofSwallows_Thin_NaturalH	.517	1	.517	.056	.814	.002	.056	.056
	NumberofSwallows_Thin_ForwardH	.440	1	.440	.063	.804	.002	.063	.057

Figure 1.

Table 5.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	NumberofSwallows__Honey_NaturalH	.011[a]	1	.011	.001	.973	.000	.001	.050
	NumberofSwallow_Honey_ForwardH	.241[b]	1	.241	.031	.861	.001	.031	.053
Intercept	NumberofSwallows__Honey_NaturalH	1549.345	1	1549.345	157.687	<.001	.823	157.687	1.000
	NumberofSwallow_Honey_ForwardH	1551.974	1	1551.974	200.304	<.001	.855	200.304	1.000
Age_Group	NumberofSwallows__Honey_NaturalH	.011	1	.011	.001	.973	.000	.001	.050
	NumberofSwallow_Honey_ForwardH	.241	1	.241	.031	.861	.001	.031	.053
Error	NumberofSwallows__Honey_NaturalH	334.065	34	9.825					
	NumberofSwallow_Honey_ForwardH	263.436	34	7.748					
Total	NumberofSwallows__Honey_NaturalH	1887.750	36						
	NumberofSwallow_Honey_ForwardH	1822.610	36						
Corrected Total	NumberofSwallows__Honey_NaturalH	334.076	35						
	NumberofSwallow_Honey_ForwardH	263.676	35						

Figure 2

Table 6.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	LipStrength_NaturalH	24.707[a]	1	24.707	.298	.589	.009	.298	.083
	LipStrength_ForwardH	9.252[b]	1	9.252	.131	.720	.004	.131	.064
Intercept	LipStrength_NaturalH	9113.041	1	9113.041	109.918	<.001	.764	109.918	1.000
	LipStrength_ForwardH	9348.252	1	9348.252	132.417	<.001	.796	132.417	1.000
Age_Group	LipStrength_NaturalH	24.707	1	24.707	.298	.589	.009	.298	.083
	LipStrength_ForwardH	9.252	1	9.252	.131	.720	.004	.131	.064
Error	LipStrength_NaturalH	2818.848	34	82.907					
	LipStrength_ForwardH	2400.303	34	70.597					
Total	LipStrength_NaturalH	11932.000	36						
	LipStrength_ForwardH	11754.000	36						
Corrected Total	LipStrength_NaturalH	2843.556	35						
	LipStrength_ForwardH	2409.556	35						

Figure 3

Table 7.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	TongueStrength_NaturalH	749.424[a]	1	749.424	7.996	.008	.190	7.996	.784
	TongueStrength_ForwardH	943.926[b]	1	943.926	13.137	<.001	.279	13.137	.941
Intercept	TongueStrength_NaturalH	107563.980	1	107563.980	1147.682	<.001	.971	1147.682	1.000
	TongueStrength_ForwardH	113301.704	1	113301.704	1576.825	<.001	.979	1576.825	1.000
Age_Group	TongueStrength_NaturalH	749.424	1	749.424	7.996	.008	.190	7.996	.784
	TongueStrength_ForwardH	943.926	1	943.926	13.137	<.001	.279	13.137	.941
Error	TongueStrength_NaturalH	3186.576	34	93.723					
	TongueStrength_ForwardH	2443.046	34	71.854					
Total	TongueStrength_NaturalH	112836.000	36						
	TongueStrength_ForwardH	118195.000	36						
Corrected Total	TongueStrength_NaturalH	3936.000	35						
	TongueStrength_ForwardH	3386.972	35						

Figure 4