EFFECTIVENESS OF ONLINE LEARNING MODULES FOR EXERCISE PROFESSIONAL CERTIFICATION GUIDELINES

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ABSTRACT

Timmons E. Williams: Effectiveness of Online Learning Modules For Exercise Professional Certification Guidelines
(Under the direction of Anthony C. Hackney)

Purpose: This study evaluated Iraqi medical students' knowledge of exercise prescription for sedentary, healthy individuals based on the ACSM guidelines after viewing a series of online learning modules. The study also tested the reliability of online learning modules as an instructional tool. **Methods:** A pilot test was performed on American medical students ($n=10$) using four online learning modules based on the ACSM guidelines for sedentary, healthy individuals to determine reliability of the pre- and post-test ($r \geq 0.70$). All modules were watched in one week to limit outside influences on knowledge acquired. Modules were then provided to Iraqi medical students ($n=20$) for the experimental component of the study. Identical pre- and post-test were used to determine knowledge acquired. **Results:** Data for both studies were found to not be normally distributed ($p<0.05$), therefore a Wilcoxon-signed test was used to test for significance of the data. The differences between pre- and post-test scores for the pilot as well as the experimental studies were found to be statistically significant ($p<0.05$). A Spearman correlation was calculated for the pre- and post-test scores for both groups ($r=0.486$ and $r=0.504$; $p<0.05$, for the pilot and experimental studies, respectively). **Conclusions:** Online learning modules significantly increased knowledge in exercise prescription guidelines in both an American and Iraqi medical school population.

To my family, thank you for all of your support.

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LIST OF ABBREVIATIONS

ACSM	American College of Sports Medicine
PNF	Proprioceptive Neuromuscular Facilitation
HRR	Heart Rate Reserve
ES	Effect Size
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
HRQL	Heath Related Quality of Life

CHAPTER I: INTRODUCTION

Introduction

The health benefits of regular exercise are widely accepted by health care professionals. Regular exercise decreases the likelihood of cardiovascular disease, obesity, type II diabetes, hypertension, and many other health conditions. Physical inactivity, however, has become more prevalent in the last 100 years as technological advancements have allowed occupational and domestic activities to become more sedentary (World Health Organization (WHO), 2015). With changes in modes of transportation and increasing urbanization, lifestyles have become more sedentary in nature. A study looking at energy expenditure in the private industry over the last five decades found that since 1960 the average daily energy expenditure from work related activity has dropped by more than 100 calories (Church et al., 2011). Church et al. found that this decrease in energy expenditure accounts for a significant portion of the increase in mean body weight in current U.S. workers. This increase in sedentary lifestyles contributes to a drastic increase in obesity rates with over two-thirds of U.S. adults classified as overweight and over one-third of U.S. adults classified as obese (Centers for Disease Control and Prevention, 2014). This trend in increasing obesity rates and physical inactivity is cause for concern and has led to the creation of both federal and public programs to combat this issue. One of the foremost groups tackling the issue of physical inactivity is the American College of Sports Medicine (ACSM).

The ACSM was founded in 1954 by a group of physicians and physical educators. The group aimed to address the health issues associated with poor lifestyle choices such as lack of physical exercise and smoking. Since its creation, the ACSM has been on the forefront of implementing scientific research into educational and practical practices in the exercise science and sports medicine field (ACSM, 2015).

By the early 1970s, several epidemiological and physiological studies had demonstrated that people participating in regular physical activity had more favorable health outcomes than less active people. These studies helped in the creation of the earliest guidelines by the American Heart Association (AHA) titled *Exercise Testing and Training of Apparently Healthy Individuals: A Handbook for Physicians.* These guidelines targeted a clinical "coronary prone" population and aimed to provide recommendations to help patients reduce cardiovascular risk while performing moderate- to high-intensity exercise (The Committee on Exercise, American Heart Association, 1972). These guidelines, along with the AHA's second publication, focused on a more clinical approach by assessing exercise capacity and potential risks of exercising patients with heart disease, rather than actually guiding people on implementing these guidelines (The Committee on Exercise, AHA, 1975).

During this time period, other health and governmental agencies began to issue recommendations for physical activity. In 1973, Michael Pollock released *The Quantification of Endurance Training Programs*, which examined research on cardiorespiratory fitness and endurance training (Pollock, 1973). All of these previous publications provided the groundwork for the ACSM Position Statement on "The Recommended Quantity and Quality of Exercise for Developing and Maintaining Fitness in Healthy Adults" in 1978. These recommendations focused on the cardiorespiratory component of physical fitness and maintaining body composition in healthy individuals (ACSM, 1978).

In the mid 1990's, the ACSM, CDC, U.S. Surgeon General, and the National Institutes of Health (NIH) convened and released a pivotal publication on physical activity and health (Morris, 1995; NIH, 1996; US Dept. et al., 1996) called *The Surgeon General's Report on Physical Activity and Exercise*. This publication called to attention to the positive relationship between regular physical activity and health rather than just the relationship between regular physical activity and improvements in fitness levels. This report aimed to clarify as a single, authoritative voice the duration and intensity of exercise needed to decrease the likelihood of disease and premature mortality, while improving health.

In 2008, an expert panel contracted by the federal government convened to examine the current research on the relationship between physical activity and health since the release of the 1996 U.S. Surgeon General's Report. The U.S. Department of Health and Human Services (USDHHS) released the federal *Physical Activity Guidelines for Americans* to provide guidance on physical activity for health promotion. The conclusions from this report differed from the 1996 guidelines by taking into account the need for separate physical activity guidelines for people of different health statuses and age. The purpose of this differentiation was to provide safe physical activity guidelines for all populations including the old, young, and ill. The document also expanded upon the differences between types of physical activity or bodily movement. Bodily movement was divided into two categories: baseline activity and health-enhancing activity. Baseline activity referred to any low-intensity activity of daily life such as walking and standing. Health-enhancing physical activity referred to any activity that produces health benefits such as brisk walking, running, or lifting weights (USDHSS, 2008).

Recommendations for physical activity have continued to evolve over the years. More recent physical activity recommendations focus more on the dose of physical activity through defining the frequency, intensity, time (duration), type (mode), volume, or progression (FITT-VP principle) of physical activity. The ACSM explicitly focuses on defining these acute variables for four different categories of training: cardiorespiratory, resistance, flexibility, and neuromotor training. The ACSM guidelines appear in the table below (Table 1).

Table 1: ACSM guidelines for sedentary, healthy individuals

	Frequency (per week)	Intensity	Time (min.)	Type	Volume	Progression
Cardio-respiratory Training	≥3-5 days	Mod: 40-60% HRR Vig: 60-90% HRR	30-60 (mod-intensity) 20-60 (vig-intensity) exercise	Rhythmic, aerobic exercise utilizing large muscle groups	≥150 min./wk	Gradual: increase in frequency and/or intensity
Resistance Training	≥2-3 days	40-50% of 1 RM	N/A	Utilizing all large muscle groups	2-4 sets of 8-10 reps or 15-20 reps*	Gradual: increase in reps and/or weight
Flexibility Training	≥2-3 days	Slight discomf-ort	Static stretch: 10-30 sec.	Static, dynamic, ballistic, and PNF	2-4 sets; 60 sec. total	N/A
Neuromot-or Training	≥2-3 days	N/A	≥20-30 min.	Balance, agility, coordination, gait exercises	N/A	N/A

*8-12 reps (improve strength and power) or 15-20 reps (improve muscular endurance)

HRR: heart rate reserve; RM: repetition maximum; N/A: not applicable or unknown; Mod: moderate; Vig: vigorous

An inverse relationship between physical activity, premature mortality and chronic disease is widely known. Even though the benefits of regular exercise are widely recognized, a reported 48 percent of American adults do not meet the 2008 Physical Activity Guidelines (CDC, 2014). This trend of increased inactivity is not exclusive to only the United States. Over 1.9 billion adults are overweight worldwide with at least 600 million of these being obese (WHO, 2015). Many developing countries have been subjected to Westernization and those associated changes in lifestyle and dietary habits (Musaiger et al., 2014).

In Iraq in particular, mortality rates from cancer, cardiovascular disease, and diabetes in adults were found to be one of the highest in the Eastern Mediterranean Region (WHO, 2011). A 2006 survey conducted by the WHO on 4800 households in 9 Iraqi governorates found that non-communicable diseases were the leading cause of morbidity or mortality. These diseases are largely the result of poor lifestyle and dietary habits. The survey also showed that in Iraq 42% of men smoke, 67% of adults have a BMI ≥25, 40.4% of adults over 40 have hypertension, and 15% of adults have diabetes. Furthermore, half of the participants surveyed reported low levels of physical activity, which was defined as not performing activities that substantially increased heart rate for ≥10 min. (Government of Iraq, Ministry of Health, & WHO, 2006).

The University of Baghdad, College of Medicine was the first medical school in Iraq and is considered one of the leading medical schools in Iraq (University of Baghdad, 2014). The curriculum is based on the British 6-year system and covers a wide spectrum of topics ranging from gross anatomy to microbiology and physiology (Richard & Wall, 2000; University of Baghdad, 2014). The curriculum, however does not include exercise physiology. The medical students learn about physiology, the functions and activities of humans, but not about exercise physiology, the study of the body's response to short- and long-term physical activity. The medical school's mission statement cites one of the main goals of the school is to prepare future doctors to be able to determine, address, and prevent the spread of current health problems in society. The medical school also aims to complete research programs on current societal problems (University of Baghdad, 2014). Inactivity is currently a health problem in society that needs to be addressed and prevented. Basic exercise prescription guidelines need to be taught to these future doctors so they can implement this knowledge into their research and help address and prevent the growing epidemic of inactivity.

Purpose

The purpose of this study was to evaluate Iraqi medical students' knowledge after completing a series of online learning modules about exercise prescription for sedentary, healthy individuals based on the ACSM guidelines. The purpose was also to test the reliability of online learning modules as an instructional tool.

Research Question

1. Does a 1-week course of 4 online learning modules improve overall knowledge about exercise prescription for sedentary, healthy individuals based on the American College of Sports Medicine guidelines?
2. Are the pre- and post-tests reliable instructional tools?

Research Hypothesis

- H1**:** A 1-week course of 4 online learning modules will improve overall knowledge about exercise prescription for sedentary individuals based on the American College of Sports Medicine guidelines.
- H2: The pre- and post-tests are reliable instructional tools.

    H2a: The instructional tools will be strongly correlated ($r \geq 0.70$).

Definition of Terms and Abbreviations

ACSM

American College of Sports Medicine is the largest sports medicine and exercise science organization in the world. The organization is dedicated in advancing scientific research while also providing educational and practical applications in the exercise science field (ACSM, 2013).

Physical Activity

Any bodily movement produced by the contraction of skeletal muscles that results in a substantial increase in caloric expenditure from rest (ACSM, 2013).

Exercise

Physical activity that is structured, planned, and involves repetitive bodily movements. This type of physical activity is completed in order to maintain or improve physical fitness (ACSM, 2013).

Physical Fitness

A set of characteristics or attributes individuals have that relate to their ability to perform physical activity (ACSM, 2013).

Sedentary

A type of lifestyle with little or no physical activity that is characterized by prolonged sitting and the absence of full-body movement (Owen et. al, 2010).

Physically Inactive Individuals

Individuals not participating in a regular exercise program or meeting the American College of Sports Medicine's guidelines of at least 150 minutes of moderate intensity exercise per week (ACSM, 2013).

Healthy

No known medical issues such as cardiopulmonary, psychiatric, metabolic, autoimmune disorders, or orthopedic issues, that would be relevant for this study.

Overweight

A body mass index (BMI) greater than or equal to 25 kg/m^2.

Obese

A BMI greater than or equal to 30 kg/m^2.

Assumptions

1. Participants actively watch all of the modules.
2. Participants are motivated to learn the subject material.
3. Learning effect will be controlled for.
4. Participants have adequate English comprehension.
5. Adherence to the honor code.

Delimitations

1. Participants will be Iraqi medical students between the ages of 18-35.
2. Participants are medical students at the University of North Carolina at Chapel Hill and University of Baghdad College of Medicine.

Limitations

1. Results may only be applicable for younger adults between the ages of 18-35.
2. Generalizability will be limited to University of North Carolina at Chapel Hill and Iraqi medical students.
3. Adherence to honor code.
4. Sample size.

Significance of study

Online learning modules have been shown to be effective in increasing knowledge in various scientific areas (Corbridge et al, 2008; Jackson et al., 2011; Roth et al., 2014). However, to the author's knowledge, the transportability of online learning modules on exercise prescription guidelines from an American to Iraqi population has not been examined. Through this study, the reliability of online learning modules on exercise prescription guidelines will be determined as well as the transferability of these modules from an American to Iraqi population. This information will be useful in determining if Iraqi medical students can also use teaching materials intended for American medical students. This, in turn, will enable future exchanges of teaching materials and collaborative research projects to be feasible.

CHAPTER II: REVIEW OF LITERATURE

Introduction

In this review, the effectiveness of online learning modules for exercise professional certification guidelines, the classification system for learning objectives based on cognitive complexity using Bloom's taxonomy, and the health effects of regular physical activity will be examined. To the author's knowledge, little research has been conducted about the efficacy of using online learning modules on health-related topics targeted towards an American audience in Iraq or another non-Western country. Hence there exists a knowledge gap and as such a need for the proposed study.

There are several points of assumption that are accepted in structuring this review of literature chapter. This review acknowledges that the content of the online learning modules created, the American College of Sports Medicine (ACSM) Guidelines, are based on valid, scientific findings (ACSM, 1978; 2013). Organizationally, the review will be separated into three sections: online modules as an instructional tool, defining learning objectives using Bloom's taxonomy, and the health effects of regular physical activity based on the US Surgeon General's report. These sections will address the reliability, validity, and effectiveness of online learning modules as an instructional tool, examine the classification of different cognitive objectives set by educators to be learned by students using Bloom's taxonomy, and review the health effects of regular physical activity based on the US Surgeon General's Report.

Online Modules as an Instructional Tool

Technology is at the forefront of modern-day life. It affects many facets of life ranging from socializing and shopping to commerce and work environments. Society today is very technology-dependent. Therefore, it is reasonable and expected to assume that the prevalence of technology in society would also be reflected in learning environments. Many medical students today are part of the Net Generation, a cohort of people born between 1982 and 1991 (Sanders & Morrison, 2007). The Net Generation is marked by the availability to instantly access limitless information via the Internet. In turn, this has changed the way that students learn compared to previous generations as student's learning styles are reflective of the environment they grew up in (Barnes et al., 2007; Sandars & Morrison, 2007). Professors are not the sole providers of information and knowledge in a class setting. Students can now search online for answers to their inquiries and further information about a topic without leaving their dorm room. This changes the dynamic between the professor and student by allowing the teacher to act as the facilitator in enhancing knowledge rather than sole source of knowledge.

Web-based learning creates an individualized learning format that lets students learn at their own pace and time of day that is conducive to their schedule and motivational levels (Goldberg, 2008; Bernado et al., 2004). This allows students to take ownership of their own learning and take a more authoritative approach in how they learn. The use of technology as an instructional tool allows for teachers to diversify their methods of teaching and thus keep the student more engaged in the learning process. Online learning tools also allow for a uniform, teaching instrument for all students regardless of racial, gender, or geographic differences (Noeth & Volkov, 2004).

The use of online learning tools to enhance education is not a novel idea. Computer based instruction has increasingly been used to teach students material rather than traditional lecture format. In response to this increase usage of online learning, research in the effectiveness of web-based learning has expanded. Research has shown that medical students can effectively learn from online instruction versus traditional lecture-based instruction (Buzzell et al., 2002; Goldberg et al., 2000; Lum & Gross, 1999; Shomaker et al., 2002). For example, a study by Buzzell et al. compared web-based tutorials, traditional lecture format, and lectures supplemented with web-based tutorials and found that mean pretest to posttest scores were not significantly different among groups (Buzzell et al., 2002). Lum and Gross found that web-based tutorials significantly increased knowledge in spirometry interpretation in medical students, interns, and senior hospital staff (Lum and Gross, 1999). In a study by Goldberg et al., student normalized mean test scores significantly improved in a virtual learning environment compared to lecture-based instruction when a lecturer presented the *same* material via virtual learning and lecture-based instruction to two separate groups of students (Goldberg et al., 2000). These studies support the notion that online instruction improves knowledge as well as or better than traditional, lecture-based learning.

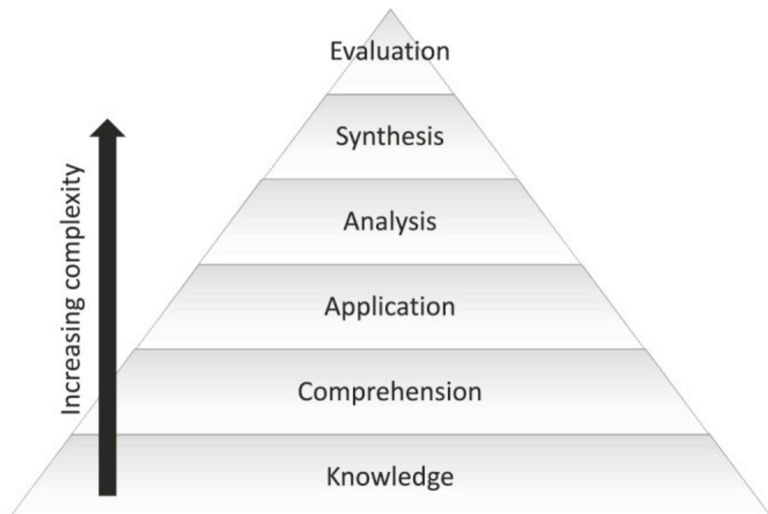
The effectiveness of online learning modules can be measured using a pre- and post-test (Buzzell et al. 2002; Goldberg, 2000; Rothe et al., 2014; Corbridge et al., 2008). The creation of a valid and reliable instrument is vital in order to determine if results are meaningful. In a study by Buzzell et al., an identical pre/post test was created and used to test student's knowledge on four body composition topics. Buzzell and his colleagues created questions pertaining to the knowledge they wanted the students' to gain (desired behavioral objectives). They enhanced validity by addressing the objectives tested throughout the online learning tutorials and evenly distributing the number of questions pertaining to each core concept or learning module (Buzzell et al., 2002).

In summary, research on the effectiveness of online learning modules in place of traditional lecture based learning is well established. The transferability of valid and effective online learning modules on exercise prescription guidelines to other countries is still unclear. The results of this study will add to the research on the effectiveness of learning modules while helping to distinguish whether using identical learning materials between countries is effective in enhancing learning.

Defining Learning Objectives Using Bloom's Taxonomy

Learning is a complex process that is made up of multiple levels of achievable expertise in a subject area. Before teachers begin the process of teaching subject material, they must determine the skills and abilities they wish for their students to acquire from their instruction. Determining this level of expertise desired allows teachers to use appropriate teaching strategies in the classroom and assessment techniques for the course. One of the most widely used frameworks for classifying desired cognitive skills is Bloom's Taxonomy. Benjamin Bloom and his colleagues created Bloom's Taxonomy in 1956. The taxonomy focuses on classifying educational goals and objectives by developing a classification system based on the three domains of learning: the cognitive, affective, and psychomotor. The taxonomy is based on the notion that a hierarchy of learning exists; i.e., a mastery of less complex learning must be achieved before advancing to more complex forms of synthesis and evaluation of a subject material (Huitt, 2011). Bloom's original taxonomy consisted of six categories of cognitive skills of increasing complexity: knowledge, comprehension, application, analysis, synthesis, and evaluation (Figure 1). As a learner increases complexity in a subject matter, deeper learning and a higher degree of cognitive processing occur (Adams, 2015).

Figure 1: Bloom's taxonomy (original)



Adams, N. E. (2015). Bloom's taxonomy of cognitive learning objectives. Journal of the Medical Library Association: JMLA, 103(3), 152.

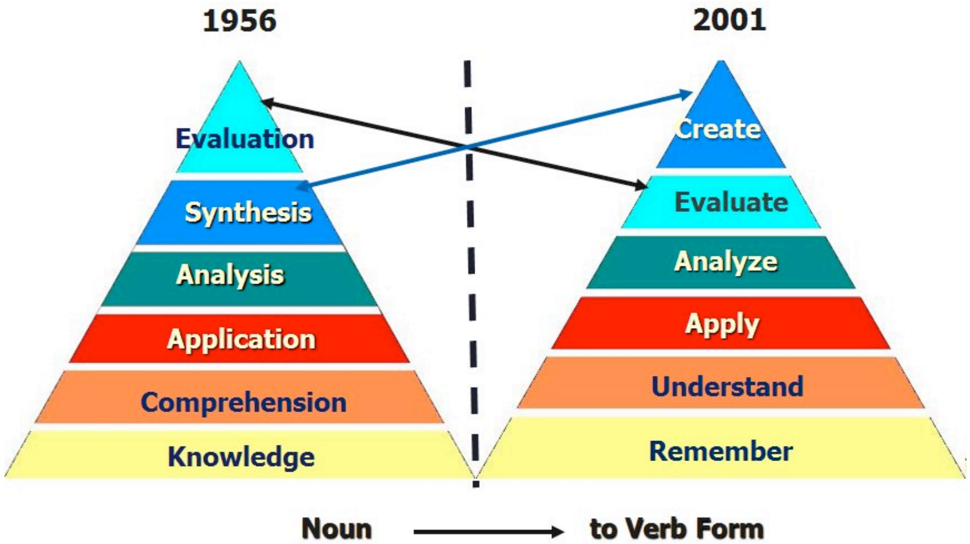
The foundation of the hierarchy of cognitive skill level in Bloom's taxonomy is knowledge. Knowledge is the ability to retain specific pieces of information such as facts, definitions, and methodology. Knowledge is assessed through examining a person's direct recognition or retention of material through assessments such as multiple choice tests and short-answer questions. This foundational level of the cognitive domain is highlighted by the ability to commit facts to memory and recall those facts when assessed (Adams, 2015).

The knowledge domain in Bloom's taxonomy is broken down into three subcategories: knowledge of specifics, knowledge of ways and means of dealing with specifics, and knowledge of universals and abstractions in a field (Krathwohl, 2002). The knowledge of specifics encompasses the ability to know terminology and specific facts. The knowledge of ways and means of dealing with specifics is characterized by the knowledge of conventions, trends and sequences, classifications and categories, criteria, and/or methodology. The knowledge of universals and abstractions in a field delineates the principles, generalizations, theories and structures in a field. Overall, this level of the cognitive domain, knowledge, must be met before moving on to the next, more complex cognitive domain of comprehension. Therefore, students must master the basic level of knowledge of a subject material before moving on to more complex ways of thinking about a topic. The other levels of the taxonomy: comprehension, application, analysis, synthesis, and evaluation; will not be discussed in relation to this research project.

This framework has since been revised to reflect modern ways of learning (Anderson, Krathwohl, et al. 2001). The revised taxonomy by Anderson et al. reworded the six cognitive domains from nouns to the verbs: remembering, understanding, applying, analyzing, evaluating, and creating. See Figure 2 for a comparison of the two taxonomies. In relation to this research project, the revision of the knowledge dimension of the taxonomy is of direct relevance as students' comprehension of the material will be tested at the knowledge level. The revised knowledge domain now referred to as remembering contains four subcategories: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge. Factual knowledge is the basic knowledge that a learner must know about a subject material. Conceptual knowledge is the interrelationships among the basic facts within a broader subject material that allow them to function together. Procedural knowledge is the ability to know how to do something. Metacognitive knowledge is the awareness and knowledge of one's own cognition (Krathwohl, 2002). A detailed look at these subcategories is shown in Table 2. Overall, in the original taxonomy, the remembrance and ability to retrieve previously learned material was the core foundation of the knowledge domain. In the revised taxonomy, the remembering domain is defined as when memory is used to produce definitions, facts or lists (Wilson, 2001).

In summary, Bloom's Taxonomy is widely used in education to classify learning objectives and goals based on the desired level of expertise an educator wants from their students. The taxonomy creates a hierarchy in learning from less to more complex cognitive learning and ability with knowledge at the foundation. Bloom's Taxonomy shows that less complex forms of learning must be mastered before moving on to more complex forms of learning. The results of this study will provide insight in the ability of online learning modules on exercise prescription to enhance knowledge/remembering. These results will hopefully provide the foundation for research in this area and allow for future research focused on enhancing more complex forms of cognitive learning about exercise prescription modules to take place.

Figure 2: Comparison of old and revised cognitive taxonomies



Wilson, L. O. (2001). *Anderson and Krathwohl – Bloom's taxonomy revised*. Retrieved August 20 2015 from http://thesecondprinciple.com/teaching-essentials/beyond-bloom-cognitive-taxonomy-revised/

Table 2: Revised knowledge domain

Factual Knowledge	**Conceptual Knowledge**	**Procedural Knowledge**	**Metacognitive Knowledge**
Terminology	Classifications and categories	Subject-specific skills and algorithms	Strategic knowledge
Specific details	Principles and generalizations	Subject-specific techniques and methods	Cognitive tasks
	Theories, models, and structures	Criteria for determining when to use appropriate procedures	Self-knowledge

<u>Health Effects of Regular Physical Activity Based on the US Surgeon General's Report</u>

The health effects of regular physical activity are well known. The Office of the Surgeon General created a report on physical activity and health in 1996 called the US Surgeon General's Report. This report summarized the current literature on the effect of physical activity in preventing diseases, the evolution of the physical activity guidelines, the physiological responses to exercise, and the trends of physical activity in the U.S. population (US Dept. et al., 1996). This report is used because it provides a comprehensive review of the scientific research about physical activity and health status and is considered a seminal work on the topic. In this review, the effect of physical activity in preventing diseases will be briefly discussed. The following diseases and conditions are primarily focused on because sufficient data exists to examine their associations with physical activity and the strength of these relationships. This review is not meant to be an all-inclusive list of all of the health effects of physical activity, but rather highlight the main relationships between health and physical activity. It should be noted that physical activity in relation to this section of the review refers primarily to endurance-type activity because most of the research at the time of the release of the Surgeon General's Report focused on the health effects of endurance-type physical activity (i.e., cardiovascular health).

Overall Mortality

Research has shown that people who engage in regular bouts of physical activity have lower mortality rates than those with sedentary lifestyles (Slattery and Jacobs, 1988; Leon and Connet 1991; Stender et al., 1993). In a study by Paffenbarger, Lee, and Leung, physical activity was used as a predictor of all-cause mortality in male Harvard alumni. The study showed that mortality risk was greatly reduced within the follow-up period for people that walked 15 or more kilometers per week (reduced to 0.67), climbed 55 or more flights of stairs per week (reduced to 0.75), were involved in moderate sports (reduced to 0.63) and were involved in 3 or more hours of moderate sports activities per week (reduced to 0.47). Most importantly, the data showed a significant relationship between decreasing risk of mortality and increasing the amount of time partaking in the aforementioned activities (Paffenbarger, Lee & Leung, 1994). This inverse association between regular physical activity and mortality is made stronger when the association measures cardiorespiratory fitness rather than the broader scope of reported physical activity (Blair, Kohl, Paffenbarger 1989). Also, a longitudinal study conducted by Blair et al. found that death rates were reduced among healthy men (aged 20-82 years) that increased their initially low levels of cardiorespiratory fitness. The study examined two maximal exercise tests on average 4.8 years apart. Participants had a follow-up to the second exercise test on average 4.7 years later to examine mortality rate (Blair et al., 1995). In summary, the data presented in the US Surgeon General's report suggest that regular physical activity, especially cardiorespiratory activity, decreases overall mortality rates in a positive dose-response fashion.

Cardiovascular Disease

Cardiovascular disease (CVD) is a major cause of death, disability, and health care expenses in the United States as one in four deaths are caused by heart disease. Low levels of physical activity have been shown to increase risk of CVD mortality and in particular coronary heart disease (CHD) mortality (Berlin and Colditz, 1990; Blair 1994; Powell et al., 1987). High blood pressure is also a major underlying cause of CVD and mortality. It is deemed the "silent killer" for its ability to cause significant damage to the heart and arteries without symptoms. Regular physical activity, however, has been shown to prevent the development of high blood pressure and reduce blood pressure in hypertensive individuals (NIH 1992, Paffenbarger et al. 1991). The effect of low levels of cardiorespiratory fitness on blood pressure levels has also been examined. A study by Blair et al. found that middle-aged individuals had a 52 percent greater likelihood of developing high blood pressure compared to individuals with moderate to high levels of cardiorespiratory fitness (Blair et al, 1984). In summary, an inverse relationship between physical activity and CVD (and in particular CHD) exists.

Obesity

Obesity is a growing epidemic in the United States. According to the Centers for Disease Control and Prevention (CDC), more than one-third of U.S. adults are considered obese (BMI > 30). Obesity increases the risk of many morbidities and mortalities such as CHD, high blood pressure, Type II diabetes mellitus, and cancer. Furthermore, the prevalence of overweight and obesity in the United States has steadily increased over the past few decades (Centers for Disease Control and Prevention, 2015).

It is commonly believed that physical inactivity directly relates to increased risk of obesity. Several reviews have looked at this relationship between physical activity and body weight and obesity. The reviews found that physical activity affects body composition by promoting fat loss and preserving or increasing lean body mass, a dose-response relationship exists between weight loss and the frequency and duration of physical activity, and the combination of increased physical activity and caloric restriction are more effective in long-term weight loss than restricting caloric intake alone (Brownell and Stunkard, 1980; Kayman, Bruvold and Stern, 1990). Also, biologically, weight gain occurs when energy intake chronically exceeds total daily energy expenditure (i.e., the energy balance equation) (Bray, 1983; Leibel, Rosenbaum, & Hirsch, 1995). Total energy expenditure is a combination of a person's resting energy expenditure, the thermic effect of food during digestion and non-resting energy expenditure (mainly physical activity). Non-resting energy expenditure accounts for approximately 30 percent of daily energy expenditure (Leibel, Rosenbaum, & Hirsch, 1995). This component of daily energy expenditure is the most variable. Therefore, increasing the amount of regular physical activity will increase non-resting energy expenditure, which can aid in weight loss or maintenance. It can then be logically deduced that regular physical activity is shown to help combat the growing epidemic of increasing obesity rates in the USA.

Health-Related Quality of Life (HRQL)

The term "health" is not solely defined by the absence of disease or illness. The World Health Organization defines health as a positive state of physical, mental and social wellbeing (World Health Organization, 2015). Therefore, the role of physical activity in promoting health should be looked at from a broader perspective than just the decreased risk of morbidities or mortalities. Kaplan and Bush introduced the term health-related quality of life (HRQL) in 1982. HRQL aims to examine the multiple facets that construct a person's overall wellbeing and satisfaction in life: the cognitive, social, physical, and emotional functioning; personal productivity; and intimacy (Shumaker, Anderson and Czajkowski, 1990). Physical activity has been shown to relate to HRQL, especially in terms of psychological wellbeing and physical functioning. A review by McAuley found that a positive relationship exists between regular physical activity and self-esteem in young adults and children (McAuley, 1994). Another study by Kruger et al. examined the relationship between HRQL, BMI and physical activity in US adults. Kruger concluded that inactive adults reported more fair to poor HRQL than active adults regardless of BMI category on a national physical activity and weight loss survey (Kruger et al., 2007). It can therefore be concluded that health-related quality of life is increased through regular physical activity.

Summary

In summary, research on the effectiveness of online learning modules as well as the positive health effects of regular physical activity are well established. Physical activity is shown to decrease the risk of mortality, cardiovascular disease, and obesity while positively increasing HRQL. It is important to teach medical students about the basics of exercise prescription guidelines because physical activity and health are inter-related. The learning will take place at the knowledge level in accordance to the hierarchy of learning illustrated by Bloom's Taxonomy. Therefore, the knowledge gained from the exercise prescription modules will directly relate to the medical students' studies on health and provide a foundation of understanding of the recommendations for regular physical activity in accordance with the ACSM guidelines. These results will hopefully provide the foundation for research in this area and allow for future research focused on enhancing more complex forms of cognitive learning about exercise prescription modules to take place.

CHAPTER III: METHODOLOGY

Participants

<u>Pilot Component</u>

Ten participants between the ages of 18-35 years old were recruited into the pilot study (5 male, 5 female). Participants were current medical students at the University of NC-Chapel Hill.

<u>Experimental Component</u>

Twenty participants between the ages of 18-35 years old participated in the study (10 male, 10 female). Participants were current medical students at the University of Baghdad College of Medicine. This was an exploratory study and to the best of the author's knowledge, this had never been done before, hence any information gained (regardless of sample size) is useful in directing future research work.

<u>Inclusion criteria</u>

- Medical students at either the University of NC-Chapel Hill (pilot study) University of Baghdad College of Medicine (experimental study).
- Access to a computer with one of the following operating systems: Microsoft Windows, Apple Mac Os X, or Linux.
- Access to high speed Internet connection with at least 500 Kbps.
- Access to Google Chrome, Firefox, Internet Explorer, Safari, or Opera.
- Able to download Adobe Flash Player version 17.0.0.169.
- Access to the website www.YouTube.com to view the online modules.

Exclusion criteria

- Prior substantial knowledge of the ACSM guidelines.
- Lack of time to complete the 4 online modules over the 1-week program.

Protocol

An identical protocol was carried out for both the pilot and experimental components.

Pre-screening

All University of North Carolina at Chapel Hill and University of Baghdad College of Medicine medical students received an official email from the principal investigator about the study, inclusion criteria, and possible benefits for participation. Interested medical students emailed the principal investigator directly in order to determine eligibility. Students that met the inclusion criteria were sent a general subject history form (Appendix 1). Selected students were then directed to the course website (exerciseprescription.web.unc.edu) to find the learning modules.

Consent/ IRB Approval

The University of North Carolina at Chapel Hill's Institutional Review Board determined that no consent process was necessary with this study protocol.

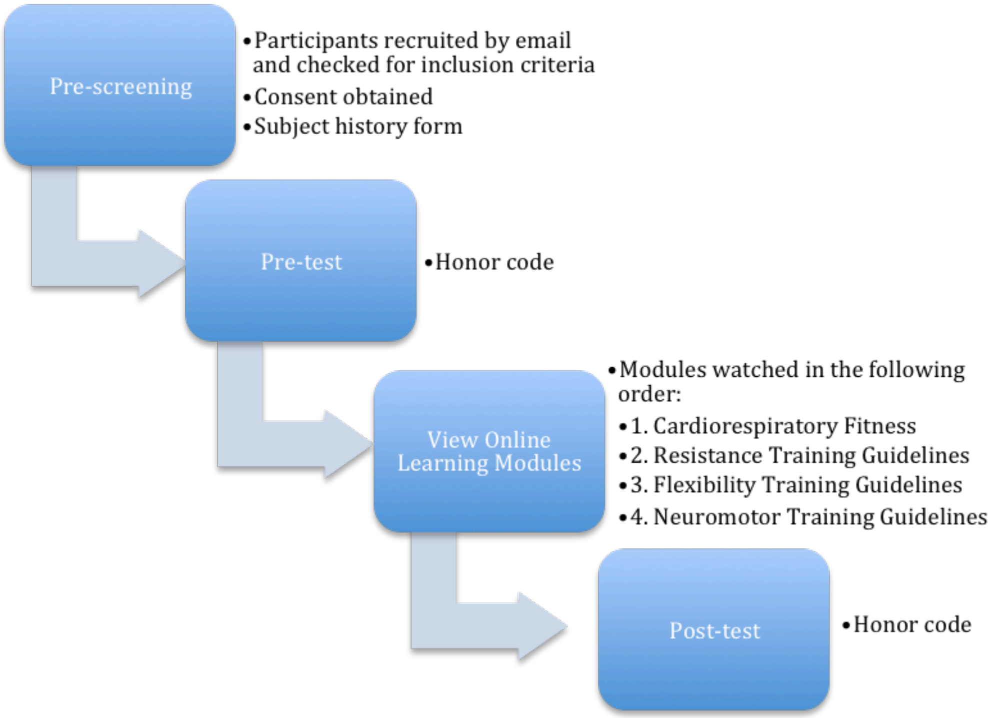
Pre- and Post-Test

All participants read and agreed to an honor code statement before beginning the pre- and post-test (Appendix 2). In agreeing to the honor code, all participants agreed to comply with not viewing any other information in regards to physical activity guidelines outside of the modules and not communicating with anyone else about information in the modules or tests. All participants completed an online test comprised of 25 questions to assess knowledge of the ACSM guidelines before and after watching all of the learning modules. The principal investigator created the test. No outside materials or help were allowed on either of the tests. The test was timed (30 min). Participants were only allowed to submit their answers once.

Learning Modules

The links to the learning modules were available through the webpage www.exerciseprescription.web.unc.edu. The principal investigator created the learning modules using PowerPoint presentations. The principal investigator recorded voiceover and the modules were uploaded to YouTube. Participants were able to watch the online modules on any computer where wireless connection was available. The learning modules were comprised of four modules on the following topics: Cardiorespiratory Fitness Guidelines, Resistance Training Guidelines, Flexibility Training Guidelines, and Neuromotor Exercise Training Guidelines. The modules each lasted 20-30 minutes. All modules must have been watched within one-week of taking the pre-test to limit possible outside influence on knowledge gained. The participants were allowed to watch the modules at any time point within the one-week program, but they must have been watched in order starting at the Cardiorespiratory Fitness Guidelines module in order to standardize the viewing of all participants. The order of the modules is presented in the flow diagram below.

Figure 3: Order of events flow diagram



Instrumentation

A brief subject history form was administered (Appendix 1). Four learning modules created using PowerPoint® slides (Microsoft, Redmond, WA) were used and Flash (Macromedia, San Jose, CA) media-based animations were incorporated within some of the slides. Audio was added to the slides using the audio function within PowerPoint. The webpage utilized for the course was created prior to the study using web.unc.edu by the principal investigator. Identical pre- and post-test on the ACSM Guidelines were administered before and after watching all of the modules. The ordering of the test questions was the same in the pre- and post-test. The test questions appear in Appendix 2.

Research Design and Statistical Analysis

This was a quasi-experimental test design, which measured the knowledge of the participants before and after the learning intervention took place. Descriptive statistics are shown as means ± standard deviations (SD). Normality was tested using a Shapiro-Wilk test for normality. A Wilcoxon Signed Test was used to compare the mean pre- and post-test scores of the participants after completing all of the online modules since the data was not normally distributed. A Spearman correlation coefficient was conducted for both the pilot and experimental components of the study to see if the pre- and post-tests score results were reliable ($r \geq 0.70$) (Linton and Gallo, 1975). Effect size was calculated for all significant measures to determine if significance had practical meaning using the Cohen *d* statistic (Cohen, 1988). The SPSS statistical software package (Version 22.0) was used to analyze data (IBM Solutions, Durham, NC, USA). Significance for all data was set at $\alpha < 0.05$ *a priori*.

CHAPTER IV: RESULTS

The goal of the study protocol was to have a sample of ten subjects in the pilot component and twenty subjects in the experimental component. Originally, the study aimed to have 10 University of NC-Chapel Hill medical students partake in the study. However, in order to obtain 10 medical students that met the inclusion criteria, medical students from another university (East Carolina) were recruited as well as from University of NC-Chapel Hill (UNC) to participate. Therefore, the pilot component participants will be referred to as American medical students rather than UNC medical students in the following pages. Overall, 10 American medical students successfully completed the pilot study.

The study aimed to have 20 Iraqi medical students from the University of Baghdad College of Medicine participate in the experimental component. Initially, 23 Iraqi medical students were recruited for the study and took the pre-test. Due to subject inability to adhere to the inclusion criteria of finishing the study within a one-week time frame, only 20 of the 23 subjects completed the project.

Subject Characteristics

The participants' demographic information for the pilot and experimental components of the study are presented in Tables 3, 4 and 5.

Table 3: Participant demographic information pilot study (n=10)

Participant	Age	Gender	Year in Medical School	Undergraduate Major
1	33	Male	4	English
2	26	Male	1	Biology
3	27	Female	4	Exercise and Sport Science
4	26	Female	4	Biology
5	28	Male	4	Biology
6	27	Male	2	Exercise and Sport Science
7	25	Male	2	Exercise and Sport Science
8	24	Female	2	Spanish
9	23	Female	2	Biology
10	26	Female	2	Psychology

Table 4: Participant demographic information pilot study: mean and range (n=10)

Measure	Mean ± SD	Range
Age	27 ± 3	23-33
Year in Medical School	3 ± 1	1 - 4

Table 5: Participant demographic information experimental study: mean and range (n=20; 10 males, 10 females)

Measure	Mean ± SD	Range
Age (yrs)	20 ± 1	19 - 21
Year in Medical School	3 ± 0	2 - 3

Pilot Component: Pre- and Post-Test Scores

Participants took a pre-test of 25 questions prior to watching all of the modules and an identical post-test after watching all of the modules within one-week. Average pre- and post-test scores are seen in Table 6. Pre-test scores averaged 11 ± 3 questions correct and post-test scores were 21 ± 4 questions correct. This equates to an average pre-test score of 43 ± 12% and to an average post-test score of 83 ± 14%. A Wilcoxon-signed test was used to test for significance of the data. The difference between pre- and post-test scores for the pilot study was found to be statistically significant ($p<0.05$). A Spearman correlation was examined to determine the association between the pre- and post-test scores and to examine the reliability of the instructional tool created. The correlation was found to not be significant ($p>0.05$) and $r=0.486$.

Table 6: Pre- and post-test scores (mean ± SD) in pilot component

Pre-Test Score (Out of 25)	Percentage Correct (%)	Range (%)	Post-Test Score (Out of 25)	Percentage Correct (%)	Range (%)
10.8 ± 3.3	43.4 ± 11.9	24 - 56	20.8 ± 3.6	83.1 ± 14.2	56 - 100

Experimental Component: Pre- and Post-Test Scores

Participants took an identical pre- and post-tests as the pilot component. Average pre- and post-test scores can be seen in Table 7. Pre-test scores were 8 ± 3 questions correct and post-test scores were 19 ± 5 questions correct. This equates to an average pre-test score of 31 ± 12% and to an average post-test score of 72 ± 20%. A Wilcoxon-signed test was used to test for significance of the data. The difference between pre- and post-test scores for the pilot study was found to be statistically significant ($p<0.05$). A Spearman correlation was examined to determine the association between the pre- and post-test scores. The correlation was found to be significant ($p<0.01$) and $r=0.504$.

Table 7: Pre- and post-test scores (experimental component)

Pre-Test Score (Out of 25)	Percentage Correct (%)	Range (%)	Post-Test Score (Out of 25)	Percentage Correct (%)	Range (%)
7.8 ± 2.9	31.2 ± 11.8	8 - 56	18.8 ± 4.7	72.4 ± 20.1	24 - 96

Comparison Between Groups

A Wilcoxon Signed Ranks Test was run to examine the difference between the percent increases in pre- to post-test scores between both the pilot and experimental components of the study. The difference was found to not be significant ($p > 0.05$). Effect size was calculated for the mean differences between the pilot and experimental groups with unequal sample size using a pre- and post-test design and Cohen's d was examined. The effect size was $d= 0.504$, which according to Hopkins is a moderate effect size (Hopkins, 2002).

Post Hoc Analysis

Cluster graphs were created in order to determine if any outliers in the data existed. A cluster graph of the pre- and post-test scores for each participant in the pilot component can be seen in Figure 4. Upon examination of Figure 4, participant one appeared to be an outlier in the data set as their pre- and post-test scores were identical whereas all of the other participants increased their pre- to post-test scores. Since the sample size was small, 10 subjects, this could have potentially influenced the correlation coefficient examined. Therefore, post hoc analysis testing was completed removing subject one in order to examine the correlation coefficient without the outlying data.

A Spearman's correlation coefficient was examined after removing subject one from the data set. The correlation was found to be significant ($p < 0.05$) with $r=0.863$. This is approaching a nearly perfect correlation according to Will Hopkins (Hopkins, 2002). A Wilcoxon Signed Ranks test was also run to see if the pre- to post-test scores were still significantly different after decreasing the sample size from 10 to 9 subjects. The difference between the pre- and post-test scores for the American medical students was found to still be significant ($p < 0.05$) after removing subject one.

A cluster graph was created to examine if any outliers in the data existed for the experimental component of the study (Figure 5). No significant outliers were found and therefore post hoc analysis was not performed.

Figure 4: Pre- and post-test scores (pilot)

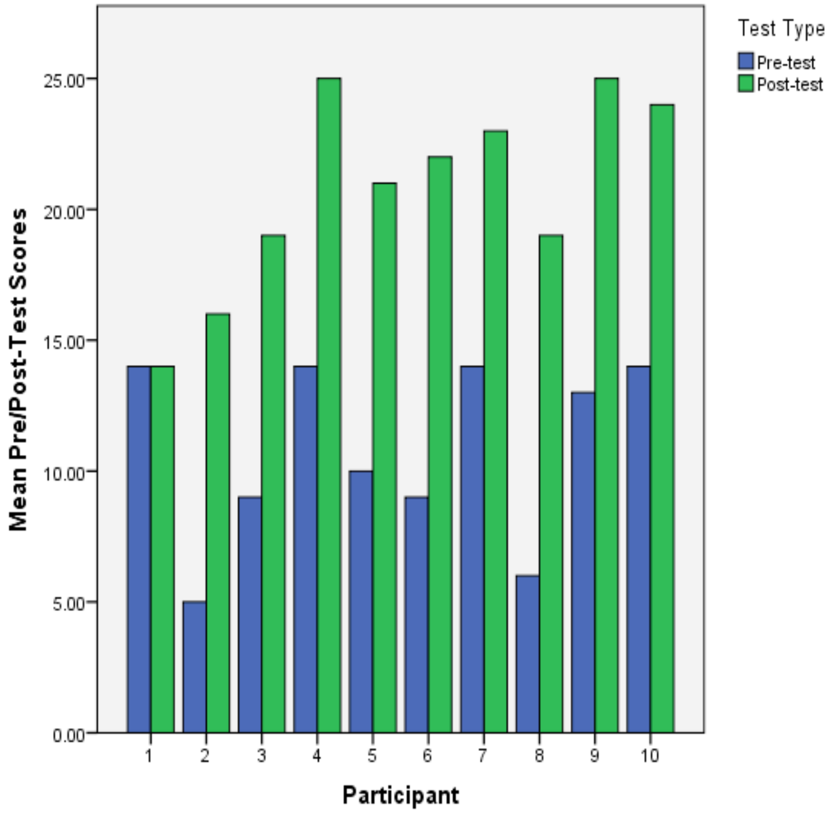
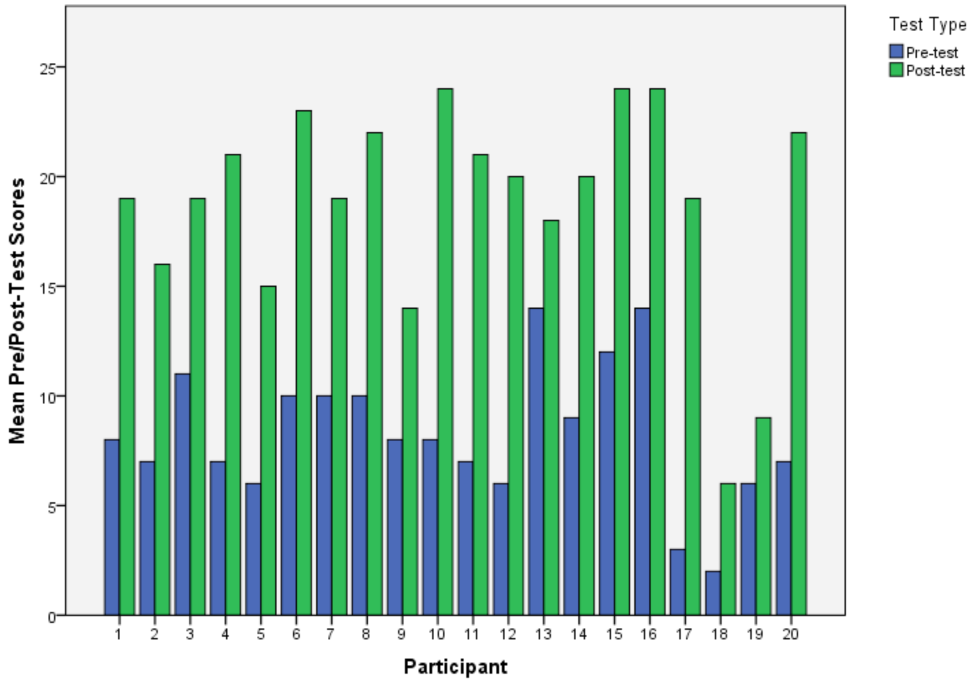


Figure 5: Pre- and post-test scores (experimental component)



CHAPTER V: DISCUSSION

The purpose of this study was to evaluate Iraqi medical students' knowledge after completing a series of online learning modules about exercise prescription for sedentary, healthy individuals based on the ACSM guidelines. The purpose was also to test the reliability of online learning modules as an instructional tool. It was hypothesized that a 1-week course of 4 online learning modules would improve overall knowledge in these medical students about exercise prescription for sedentary individuals based on the American College of Sports Medicine guidelines. It was also hypothesized that the online learning modules are reliable instruments and thus strongly correlated ($r \geq 0.70$). These hypotheses were tested by having two different study groups (American and Iraqi medical students respectively) complete a pre-test prior to watching four online learning modules on exercise prescription followed by taking an identical post-test.

Pilot Study: Pre- and Post-Test Scores

Ten American medical students took an identical pre/post-tests after watching four online learning modules about exercise prescription. Post-test scores improved from an average of 11 ± 3 questions correct on the pre-test to 21 ± 4 questions correct on the post-test. This equates to an average pre-test score of 43 ± 12% and to an average post-test score of 83 ± 14%. Therefore, on average, American medical students almost doubled their pre- to post-test scores after watching the online learning modules. Thus, it can be concluded that participant knowledge about exercise prescription on average almost double from pre- to post-test. This increase was found to be significant ($p < 0.05$).

These findings are consistent with other published research on the effectiveness of online teaching modules. A study on ambulatory care advanced pharmacy practice experiences used a pre/post-test design to assess knowledge gained from watching online learning modules on the 10 core concepts of ambulatory care. The study found that participants that watched online learning modules improved their average pre-test score from 65.1% to an average of 86.3% on the post-test (Harris et al., 2016).

Another study focusing on knowledge gained through using online learning practices specifically in an American medical student population found that students that used online web-based quizzes to prepare for final examinations in medical microbiology scored significantly higher than students who used traditional print textbooks. Moreover, the study showed that of the 71 participants that partook in the study, those that were assigned to the web-based learning group scored higher on questions designed to test synthesis of knowledge and analysis of data (Johnson, 2008).

Finally, a study at Kansas State University found that students' performance significantly increased 10% (from 79 to 89%) from the pre- to post-test after taking an online course indicating that the students learned concepts presented in the modules (Domenghini et al., 2014). This study, as well as the other studies cited in this discussion, clearly depict the positive increase in participants' knowledge base after partaking in an online learning course and thus support the results found in this study.

Experimental Study: Pre- and Post-Test Scores

Twenty Iraqi medical students completed the pre and post-test. Post-test scores improved from an average of 8 ± 3 questions correct to an average of 19 ± 5 questions correct on the post-test. This equates to an improvement of around 40% increase in post-test scores (from an average pre-test score of 31 ± 12% to an average post-test score of 72

± 19%). Therefore, on average, Iraqi medical students more than double their pre- to post-test scores after watching the online learning modules. Thus, Iraqi students that completed the study more than doubled their knowledge base of exercise prescription guidelines after participating in the study.

Little research has been conducted on the effectiveness of online learning modules in an Iraqi population. Therefore, other studies on distance learning in non-Western countries will be cited. A study conducted by the Queensland University of Technology in Australia looked at the effectiveness of online distance learning in nurse education for Vietnamese nurses. The study aimed to assess the effectiveness of the module towards a population that was not native English speakers. The researchers found that of the 29 that completed the study, 22 passed with sufficient knowledge gained from the module with a score of >50% (Lewis et al., 2012).

Another study by Farooq et al. looked at online English language teacher education utilizing distance education with 26 Pakistan students as participants. The researchers aimed to examine if an online learning environment would improve knowledge in English language teacher education in a developing country. The study found that pre- to post-test scores significantly improved and thus the means of online learning instruction were successful in increasing knowledge in the field of teacher education programs (Farooq et al., 2012). Therefore, these studies support the significant findings in this study when using online learning modules to teach a foreign audience.

Improvement in Knowledge of Exercise Prescription Guidelines Between Groups

Pre- and post-test scores were examined for both the pilot (American) and experimental (Iraqi) groups. It is seen through examining the results of the post-test that the experimental group improved their pre- to post-test scores more than the American group (a 41% increase in the Iraqi population compared to a 40% increase in the American population). However, this 1% difference between groups is small enough to be negligible and could possibly be due to the small sample size in the pilot study. Therefore, it can be concluded that both groups improved their knowledge relatively the same amount as seen from the percentage increases in pre- to post-test scores after watching the online learning modules.

Overall, both the pilot and experimental study groups saw significant increases in knowledge from pre- to post-test. It was also shown that both groups increased knowledge by the same percentage amounts (~40% increase). Therefore, the study showed that Iraqi medical students increased their knowledge on exercise prescription guidelines just as well as the American medical students.

Reliability of the Pre/Post Test

A Spearman correlation coefficient was examined within both test groups to test the reliability of the pre/post-test created. The correlation determined if a linear relationship between the pre- and post-test scores existed. Therefore, a strong positive correlation would show that participants that scored poorly on the pre-test would also not score highly on the post-test. Likewise, participants that initially scored high on the pre-test would be expected to score high on the post-test if the correlation between the variables was strong. Therefore the consistency of the instrument would be determined.

The Spearman correlation was found to be $r=0.486$ (not significant; $p > 0.05$) for the pilot group. The pilot study's correlation coefficient of $r=0.486$ implies that a large relationship exists between the pre- and post-test scores (Hopkins, 2002). Since the findings were not found to be significant ($p > 0.05$), the number of test questions answered corrected on the pre-test did not significantly correlate with the number of questions answered correctly on the post-test and thus the instrument created (pre/post-test) was not found to be significantly reliable for the pilot group. The lack of significant findings for the pilot group may be due to the small sample size of 10 participants and also due to the exercise science knowledge base of the American medical students in exercise and sport science majors as reflected in Table 3. Another potential influence could be participant one's lack of change from pre- to post-test scores, which could have potentially influenced the correlation coefficient because of the small sample size. Upon removing this subject in post hoc analysis, the correlation coefficient was found to be $r=0.863$, which is considered a very large or nearly perfect correlation (Hopkins, 2002). Therefore, subject one's data may have skewed the data and affected the interpretation of the correlation coefficient and the interpretation of the reliability of the pre- and post-test for the pilot component.

The Spearman correlation was found to be $r=0.504$ (significant; $p < 0.05$) for the experimental group. This implies that a significant correlation between pre- and post-test scores for the Iraqi medical students existed.

Comparison Between Groups

The Wilcoxon Signed Ranks Test revealed the difference between the percent increases in pre- to post-test scores between both the pilot and experimental components of the study was not significant ($p > 0.05$). Therefore, it is shown that Iraqi and American medical students in the study did not significantly differ in their percentage increase in test scores from pre- to post-test on exercise prescription guidelines.

Effect size is the magnitude of difference between the two groups and also helps identify substantive significance of the data rather than just statistical differences within the data that a p-value would reveal. In other words, a p-value reveals that an effect exists; however, the effect size reveals the size of that actual effect. Effect size was calculated for the mean differences between the pilot and experimental groups with unequal sample size using a pre- and post-test design and was found to be d=0.504. According to effect size conventions proposed by Will Hopkins, this would be classified as a moderate effect size (Hopkins, 2002). Therefore, it is seen that the practical significance of the differences between the pre- and post-test scores for both groups is of moderate difference. This may due to the fact that one third of the American medical students had a background in exercise sport science as an undergraduate degree, which may have exposed them to more exercise prescription principles than the Iraqi medical students.

Conclusions

Overall, both the pilot and experimental study groups saw significant increases in knowledge from pre- to post-test. It was also shown that both groups increased knowledge by relatively the same percentage amounts (~40% increase). Therefore, the study showed that Iraqi medical students increased their knowledge on exercise prescription guidelines just as much as the American medical students. It can be concluded that online learning modules created for an American audience successfully increase knowledge both an American and Iraqi audience in exercise prescription guidelines. Also, the creation of a pre/post-test to be used to evaluate knowledge for exercise prescription guidelines was found to be moderately reliable and strongly reliable ($p < 0.05$) in the pilot and experimental components of the study respectively. Thus, the transferability of online learning modules between countries is feasible and is shown to increase knowledge base in exercise prescription guidelines.

Limitations

Limitations to the study do exist. The sample size relative to evaluating the effectiveness of online learning modules and reliability of instrumentation may have been inadequate and thus limited the practical application of the significant results found. Furthermore, a larger sample would have allowed for more breadth in knowledge gained about the effectiveness of transporting online learning modules from an American to Iraqi medical student population. Also, a survey could be used after completing the study to allow participants to evaluate the online learning modules and allow for future modification and improvement of the materials.

Future Studies

Future studies should consider obtaining a greater number of subjects in order to reach optimal statistical power. Overall, larger future studies are needed to further understand how transportable online learning modules created for an American audience are for an Iraqi population of medical students. Also, studies looking at the effectiveness of online learning modules in increasing knowledge in different topic areas outside of exercise prescription would allow researchers to see if online teaching materials effectively enhance learning in a multitude of subject areas. The population could also be expanded into other fields other than just medical students to see if online learning modules could effectively teach participants of varying educational backgrounds.

APPENDIX 1: SUBJECT DEMOGRAPHIC QUESTIONS

Please provide the following information about yourself:

- Age:
- Gender:
- Undergraduate degree major (if applicable):
- Year in medical school

APPENDIX 2: PRE- AND POST-TEST

UNC Honor Pledge: I certify that no unauthorized assistance has been received or given in the completion of this work.

You may NOT use any outside resources in completing this test.

A. I agree
B. I do not agree

Have you viewed the online learning modules prior to taking this test?

A. Yes
B. No

The questions are based on the American College of Sports Medicine's recommendations for sedentary, healthy adults.

1. What does the acronym FITT-VP stand for?
   A. Frequency, Intensity, Time, Type, Volume, Progression
   B. Frequency, Intensity, Time, Type, Variation, Progression
   C. Frequency, Intensity, Tempo, Type, Volume, Progression
   D. Frequency, Intervals, Time, Type, Variation, Progression
   E. None of the above

2. What is the recommended frequency for cardiorespiratory training per week?
   A. ≤ 2 days per week of vigorous intensity exercise
   B. ≥ 3 days per week of vigorous intensity exercise
   C. ≥ 5 days per week of moderate intensity exercise
   D. Combination of B & C
   E. Combination of A & C

3. What is the recommended intensity for cardiorespiratory training per exercise session?
   A. Moderate: 40-60% HRR
   B. Vigorous: 60-70% HRR
   C. Vigorous: 60-90% HRR
   D. Both A & B
   E. Both A & C

4. What is the recommended duration (time) for cardiorespiratory training per exercise session?
   A. 20 – 30 min/day of moderate intensity exercise
   B. 30 – 60 min/day of moderate intensity exercise
   C. 20 – 60 min/day of vigorous intensity exercise
   D. Both A & C
   E. Both B & C

5. What is the recommended type of cardiorespiratory training?

A. Rhythmic, aerobic exercise
B. Utilizes large muscle groups
C. Requires little skill
D. All of the above
E. None of the above

6. What is the recommended volume of cardiorespiratory training per week?
   A. ≥ 500-1000 MET-min/week
   B. 1000 kcal/week
   C. ~150 min/week moderate intensity exercise
   D. ≥ 5400-7900 steps/day
   E. All of the above

7. What is the recommendation for progression of cardiorespiratory training?
   A. Increase time (duration) first
   B. Increase frequency first
   C. No set recommendation, but gradual progression of exercise time, frequency and intensity is recommended for best adherence and least injury risk.
   D. All of the variables of the FITT-VP principle should be progressed simultaneously
   E. It is not recommended that cardiorespiratory training be progressed

8. What is the recommended frequency for resistance training per week?
   A. 2 – 3 days per week
   B. 3 – 5 days per week
   C. ≥ 5 days per week
   D. Combination of B & C
   E. None of the above

9. What is the recommended intensity for resistance training per exercise session for sedentary, healthy individuals?
   A. 40 – 50 % 1-RM
   B. 50 – 60% 1-RM
   C. 60 – 70% 1-RM
   D. None of the above
   E. All of the above

10. What is the recommended duration (time) for resistance training per exercise session?
    A. 20 – 30 min/day
    B. 30 – 60 min/day
    C. 60+ min/day
    D. No specific duration recommendation
    E. None of the above

11. What is the recommended type of resistance training?
    A. Multi-joint exercises affecting >1 muscle group

B. Exercises that target agonist and antagonist muscle groups
C. Single joint exercises targeting major muscle groups
D. Exercises that target all muscle groups
E. All of the above

12. What is the recommended volume of resistance training per week?
A. 2 - 4 sets per muscle group, 8 -12 repetitions, rest 2 – 3 minutes
B. 2 - 4 sets per muscle group, 12 -15 repetitions, rest 2 – 3 minutes
C. 3 - 5 sets per muscle group, 8 -12 repetitions, rest 2 – 3 minutes
D. 3 – 5 sets per muscle group, 12 -15 repetitions, rest 2 – 3 minutes
E. None of the above

13. What is the recommendation for progression of resistance training?
A. Gradual progression of the frequency, intensity, or volume (repetitions and sets) of exercise
B. Focusing on the principle of overload, specificity, and variation
C. Both A & B
D. All of the variables of the FITT-VP principle should be progressed simultaneously
E. It is not recommended that resistance training be progressed

14. What is the recommended frequency for flexibility training per week?
A. ≤ 2 days per week
B. ≥ 2 - 3 days per week
C. Daily stretching is most effective
D. Combination of B & C
E. Combination of A & C

15. What is the recommended intensity for flexibility training per exercise session?
A. Stretch to the point of feeling tightness or discomfort
B. Stretch to the point of feeling pain
C. Stretch to the point of feeling comfort
D. Both A & C
E. None of the above

16. What is the recommended duration (time) for flexibility training per exercise session?
A. 5 seconds static stretching
B. 10 – 30 seconds static stretching
C. 30 – 60 seconds static stretching
D. Static stretching is never recommended
E. None of the above

17. What is the recommended type of flexibility training?
A. Static, Dynamic, Ballistic
B. Static, Active Static, Dynamic, Ballistic

C. Static, Active Static, Passive Static, Dynamic, Ballistic
D. Static, Active Static, Passive Static, Dynamic, Proprioceptive neuromuscular facilitation (PNF), ballistic
E. None of the above; ballistic stretching is not recommended

18. What is the recommended volume of flexibility training per week?
A. 60 seconds of total stretching time for each exercise by performing each exercise 2-4 times
B. 60 seconds of total stretching time for each exercise by performing each exercise 1 time
C. 120 seconds of stretching time for each exercise by performing each exercise 2-4 times
D. 120 seconds of stretching time for each exercise by performing each exercise 1 time
E. None of the above

19. What is the recommendation for the progression of flexibility training?
A. Increase time (duration) first
B. Increase frequency first
C. No set recommendation; unknown
D. All of the variables of the FITT-VP principle should be progressed simultaneously
E. It is not recommended that flexibility training be progressed

20. What is the recommended frequency for neuromotor training per week?
A. ≤ 2 days per week
B. 2 – 3 days/week
C. ≥ 5 days per week of moderate intensity exercise
D. Unknown
E. None of the above

21. What is the recommended intensity for neuromotor training per exercise session?
A. Moderate
B. Vigorous
C. Both A & B
D. An effective intensity not yet determined
E. None of the above

22. What is the recommended duration (time) for neuromotor training per exercise session?
A. 10 – 20 min/day
B. 20 – 30 min/day
C. 30 – 60 min/day

D. 60+ min/day
E. None of the above

23. What is the recommended type of neuromotor training?
    A. Exercises involving motor skills (e.g. balance, agility, coordination, gait)
    B. Exercises involving proprioceptive exercise training
    C. Exercises involving multifaceted activities (e.g., tai chi, yoga)
    D. All of the above
    E. None of the above

24. What is the recommended volume of neuromotor training per week?
    A. 30 min/week
    B. 60 min/week
    C. 90 min/week
    D. 150 min/week
    E. No set recommendation; unknown

25. What is the recommendation for progression of neuromotor training?
    A. Increase time (duration) first
    B. Increase frequency first
    C. No set recommendation, unknown
    D. All of the variables of the FITT-VP principle should be progressed simultaneously
    E. It is not recommended that neuromotor training be progressed

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