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Psychological effects of testosterone replacement therapy for secondary hypogonadism

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Walden University
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Abstract

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MS, Walden University, 2016

Dissertation Submitted in Partial Fulfillment

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Abstract

Hypogonadism negatively impacts various psychological aspects of a male's life. Males under the age of 50 who experience symptoms of depression or a decreased sense of well-being may not be aware that secondary hypogonadism might be the underlying cause. A gap exists in the literature regarding the psychological effects of testosterone replacement therapy used to treat hypogonadism. The current research project was framed by Engel's biopsychosocial theory, which encompasses the biological, psychological, and social aspects of a client's life. The research objective was to determine the relationship between testosterone replacement therapy and the psychological effects of depression and quality of life amongst males under the age of 50 who have been diagnosed with secondary hypogonadism. Secondary data were gathered on 17 males with the assistance of a health clinic on the East Coast of the United States. Statistically significant differences were found in the reported levels of depression and quality of life. This study provides additional guidance to clinical psychologists, primary-care physicians, psychiatrists, pediatricians, endocrinologists, and internal medicine specialists who see males under the age 50 in their practice settings. The results of this study could influence positive social change by increasing awareness of a medical issue that can mimic symptoms of depression and anxiety.

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Dedication

This dissertation is dedicated to everyone who has helped me along my journey, to get to where I am today completing this milestone in my life. That even includes the one guy who yelled at me in the candy isle at Circle K when I was 12 because he thought I was being “too rambunctious” with the Skittles. Even though that was an asshole thing to say, that individual helped teach me lessons that I still implement to this day.

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I would like to thank my partner for the countless cups of tea he made and brought to me over the years. He is my always and forever.

I would like to thank all my cats for the countless hours of companionship they provided me while I worked through this milestone of my life.

Finally, I would like to thank Socrates the Greek philosopher from whom I've learned: smart people learn from everything and everyone, average people learn from their experiences, and ignorant people don't learn anything because they already have all the answers.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Secondary hypogonadism occurs when the hypothalamus or pituitary gland fails to produce an adequate amount of testosterone (Akturk & Nippolt, 2016; Dudek et al., 2017; Plessis, et al., 2019; Tarnutzer, 2015). Known causes of secondary hypogonadism include genetic defects, severe stress, drug use, long-term medical diseases, or damage to the hypothalamus or pituitary gland (Bhasin et al., 2018; Dhindsa et al., 2018; Forni & Wray, 2015; Issacs & Thomas, 2015; Lasaite et al., 2016; McCullough, 2015). Secondary hypogonadism adversely affects specific psychological aspects of a male's life including introducing or increasing symptoms of depression and reducing quality of life (Akturk & Nippolt, 2016; Izzo, 2016; Lasaite et al., 2016; Plessis et al., 2019; Shiraishi et al., 2014). One possible treatment for secondary hypogonadism is testosterone replacement therapy (Barton et al., 2016; Jung & Shin, 2016; Morales et al., 2015; Sterling et al., 2015). However, there is only limited research about the psychological effects of this treatment method (Aydogan et al., 2012; Konaka et al., 2016; Lee & Tillman, 2016).

In the current quantitative study, I analyzed the psychological effects of testosterone replacement therapy for males under the age of 50, with secondary hypogonadism, over a 2-month period. The study has several implications for positive social change which include (a) providing a scholarly contribution to the sparse research on this important subject; (b) increasing awareness of a medical issue that can mimic symptoms of depression, anxiety, and various other diagnoses described in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association [APA], 2013); and (c) providing an assessment of the

psychological effects and efficacy of a largely unexamined invasive treatment option on an underserved population (Issacs & Thomas, 2015; Kim et al., 2016; Lee & Tillman, 2016; Veras & Nardi, 2010).

In Chapter 1, I provide background information on the psychological effects of testosterone replacement therapy for males with secondary hypogonadism. This chapter also includes a presentation of the research problem, the quantitative design and variables of the current study, and the research questions (RQs) and hypotheses. The purpose and nature of the study, the methodology and theoretical orientation, and definitions for key terms and constructs operationalized in the study are included as well. I also address the assumptions, scope and delimitations, limitations, significance, and social change implications before providing a summary of the chapter.

Background

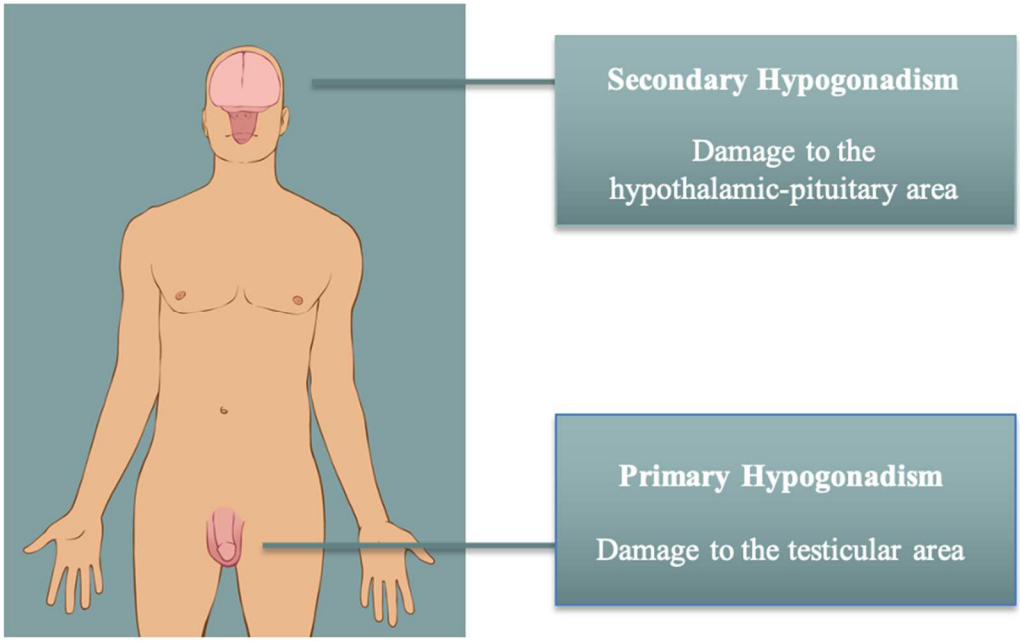
Hypogonadism, more commonly known as low testosterone, is a medical issue that primarily impacts the male population (Bandari et al., 2017; Basaria, 2014; Bhasin et al., 2018; Winters & Huhtaniemi, 2017). The condition occurs when the body fails to create an adequate amount of testosterone (Basaria, 2014; Bhasin et al., 2010; Morgentaler et al., 2016). Although a significant number of males are directly impacted by hypogonadism, not everyone is cognizant that the issue exists (Basaria, 2014; Bhasin et al., 2010; Winters & Huhtaniemi, 2017). Some males are aware that they have hypogonadism, while others are unaware of the medical issue because the symptoms result from or mimic other psychological concerns and conditions (Basaria, 2014; Bhasin et al., 2018; Lee & Tillman, 2016; Tanriverdi & Kelestimur, 2015). Although

hypogonadism can affect males at any age, it is more commonly looked at and tested for in older males because testosterone levels naturally decrease with age (Akturk & Nippoldt, 2016; Busnelli et al., 2017; Cohen et al., 2020; Dudek et al., 2017; Hackett, 2016; Huo et al., 2016; Mascarenhas et al., 2016; Nian et al., 2017; Yazdani & Branch, 2018).

Subcategories of hypogonadism include both primary (hypergonadotropic hypogonadism) and secondary (hypogonadotropic hypogonadism) types (Akturk & Nippolt, 2016; Basaria, 2014; Javed et al., 2015; Lee & Tillman, 2016; Morales et al., 2015; Plessis et al., 2019; Sterling et al., 2015). Primary hypogonadism means that the inner workings of the pituitary gland or hypothalamus are functioning as they should, but there is a problem or issue with the testicles (Basaria, 2014; Bhasin et al., 2018; Javed et al., 2015; Lee & Tillman, 2016; Sterling et al., 2015; Winters & Huhtaniemi, 2017). Secondary hypogonadism means that the testicles are functioning as they should, but there is a problem or issue with the inner workings of the pituitary gland or hypothalamus (Akturk & Nippolt, 2016; Bhasin et al., 2018; Dudek et al., 2017; Plessis et al., 2019; Winters & Huhtaniemi, 2017). In the current study, I was interested in secondary hypogonadism, which results from damage to the hypothalamic-pituitary region of the brain (Akturk & Nippolt, 2016; Barton et al., 2016; Plessis et al., 2019; Taylor et al., 2017). Figure 1 provides an illustration of primary and secondary hypogonadism.

Figure 1

An Illustration of Primary and Secondary Hypogonadism



Note. (K. Davis, personal communication, May 14, 2021). Reprinted with permission (see Appendix A).

Secondary hypogonadism can result from various congenital or acquired issues including Kallmann syndrome and traumatic brain injury (Barton et al., 2016; Dwyer et al., 2019; Forni & Wray, 2015; Maione et al, 2018; Ruiz et al., 2016; Sterling et al., 2015; Taylor et al., 2017; Tritos et al., 2015). Kallmann syndrome is a congenital condition resulting from the deficient production of certain hormones produced in the hypothalamus (Dwyer et al., 2019; Maione et al., 2018; Ruiz et al., 2016). Traumatic brain injury is an acquired condition resulting from sudden physical damage to the brain

(Hackenberg & Unterberg, 2016). At the time of this study, a gap existed in the literature regarding the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism (Hackett, 2016; Izzo, 2016; Konaka et al., 2016; Lee & Tillman, 2016). In the current study, I addressed this gap in the literature.

Problem Statement

For an average male, the typical range of testosterone is between 250 and 950 nanograms per deciliter (Bhasin et al., 2018; Morales et al., 2015; Saad et al., 2016; Sterling et al., 2015). When the testosterone level becomes deficient, the male with secondary hypogonadism tends to experience negative sexual and somatic effects (Akturk & Nippolt, 2016; Aydogan et al., 2012; Dhindsa et al., 2018; Hackett, 2016; Lee & Tillman, 2016; Snyder et al., 2016; Yassin et al., 2016). Secondary hypogonadism also negatively impacts various psychological aspects of a male's life including introducing or increasing symptoms of depression and decreasing the quality of life (Akturk & Nippolt, 2016; Aydogan et al., 2012; Huo et al., 2016; Hwang & Miner, 2015; Javed et al., 2015; Lasaite et al., 2016; Morales et al., 2015; Shiraishi et al., 2014; Uddin et al., 2017).

Testosterone replacement therapy is a viable option to treat and ameliorate the undesired psychological affects commonly associated with secondary hypogonadism (Barton et al., 2016; Cherrier et al., 2015; Mohamad et al., 2018; Morales et al., 2015). A small amount of research exists on the psychological effects of testosterone replacement therapy, but this literature primarily focuses on the aging male population, which is comprised of individuals diagnosed as having late-onset hypogonadism (Busnelli et al., 2017; Cherrier et al., 2015; Dudek et al., 2017; Hackett, 2016; Konaka et al., 2016; Lee &

Tillman, 2016; Snyder et al., 2016). This lack of research on young men is concerning because age is not an exemption from secondary hypogonadism (Aydogan et al., 2012; Bouvattier & Young, 2020; Dhindsa et al., 2018; Forni & Wray, 2015; Lucas-Herald, 2018). For example, a young adult who plays football in college or an adolescent who falls off their bicycle could have head trauma and not realize it. Not every individual who participates in contact sports or hits their head will end up with a traumatic brain injury resulting in secondary hypogonadism, but for some it is a possibility and reality (Rey & Grinspon, 2020).

Males under the age of 50 who experience depressive symptoms or a decreased sense of well-being may not be aware that hypogonadism might be a possible cause (Basaria, 2014; Bhasin et al., 2018; Lee & Tillman, 2016; Tanriverdi & Kelestimur, 2015). For males of any age who suffer from negative psychological effects of secondary hypogonadism, testosterone replacement therapy may be a practical and beneficial solution (Aydogan et al., 2012; Cherrier et al., 2015; Huo et al., 2016; Lasaite et al., 2016; Lee & Tillman, 2016; Snyder et al., 2016). Researchers have been quick to highlight the sexual and somatic effects of testosterone replacement therapy for males (Hackett, 2016; Huo et al., 2016; Hwang & Miner, 2015; Morales et al., 2015; Yassin et al., 2016). The problem remains that researchers often overlook the psychological effects of testosterone replacement therapy for younger males (Hackett, 2016; Huo et al., 2016; Hwang & Miner, 2015; Morales et al., 2015; Yassin et al., 2016). A lack of scientific research focused on the younger male population in the literature indicates a need for additional psychological studies. Clinicians can use the results of the current study to

evaluate the psychological effects and efficacy of an underanalyzed treatment possibility for an overlooked, underserved, and susceptible population.

Purpose of the Study

The purpose of this quantitative study was to investigate the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. This study consisted of one independent variable (time exposed to testosterone replacement therapy) and two dependent variables (quality of life and depression). Looking at the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism begins to address the gap in the current literature (Huo et al., 2016; Konaka et al, 2016; Morales et al, 2015; Shin et al., 2016). The research objective was to determine the relationship between testosterone replacement therapy and the psychological effects of depression and quality of life amongst males under the age of 50 who have been diagnosed with secondary hypogonadism.

Research Questions and Hypotheses

To achieve the research objective, I investigated the following RQs and hypotheses:

RQ1: Is the psychological aspect of quality of life significantly affected by testosterone replacement therapy maturation?

$H_0$1: The mean scores for the psychological aspect of quality of life, as assessed by the Quality of Life Scale (QoLS) do not differ significantly over baseline, 1

month, and 2 months of testosterone replacement therapy duration in males under the age of 50 suffering from secondary hypogonadism.

H_a1: The mean scores for the psychological aspect of quality of life, as assessed by the QoLS do differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy duration in males under the age of 50 suffering from secondary hypogonadism.

RQ2: Is the psychological aspect of depression significantly affected by testosterone replacement therapy maturation?

H_02*:* The mean scores for the psychological aspect of depression, as assessed by the Patient Health Questionnaire-9 (PHQ-9), do not differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy duration in males under the age of 50 suffering from secondary hypogonadism.

H_a2*:* The mean scores for the psychological aspect of depression, as assessed by the PHQ-9, do differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy duration in males under the age of 50 suffering from secondary hypogonadism.

Theoretical Framework

The theoretical framework used in this research was Engel's (1977) biopsychosocial model (see also Guillemin & Barnard, 2015; Gupta & Venkatesan, 2018; Jorn, 2015; Pletikosic et al., 2018). Engel introduced his concept in a 1977 article in which he explained the need for a new medical model (see also Jorn, 2015; Vongas & Alhaji, 2015; Wade & Halligan, 2017). The biopsychosocial model is an approach that

considers the significance of analyzing a client within their fullest context (Engel, 1977; Gupta & Venkatesan, 2018; Wade & Halligan, 2017). Engel's biopsychosocial model considers the biological, the psychological, and the social aspects of a client's life and how they intertwine with and react to one another (Guillemin & Barnard, 2015; Wade & Halligan, 2017). The model suggests a correlation between the mind and the body (Engel, 1977; Gupta & Venkatesan, 2018; Vongas & Alhaji, 2015). I discuss this model in more detail in chapter 2.

Clinicians use the biopsychosocial model to provide structure for client interaction and as a perspective framework for how they see clients and provide care (Engel, 1977; Vongas & Alhaji, 2015; Wade & Halligan, 2017). In medical sociology, sickness is an all-encompassing term with causes such as various microorganisms, any number of physiological malfunctions, and everyday life (Aydogan et al., 2012; Illiffe, 2017; Pletikosic et al., 2018). Quality of life and depression are factors influenced by various biological, psychological, and social realms of a client's life (APA, 2013; Barton, 2016; Burckhardt & Anderson, 2003; Chen et al., 2016). Low testosterone can create inabilities for an individual in each of the three biopsychosocial realms; this unfortunately can result in negative somatic, psychological, and social complications (Hackenberg & Unterberg, 2016; Morales et al., 2015; Vongas & Alhaji, 2015). Low testosterone can also create a vicious cycle of physical health complications that create mental health complications and vice versa (Dudek et al., 2017; Grabner et al., 2017; Johansen, 2016; Morales et al., 2015; Stancampiano et al., 2019).

Nature of the Study

This study was nonexperimental, quantitative, and correlational in nature. Quantitative research is an adequate and sufficient approach when determining if a relationship exists between variables and evaluating various theories (Creswell, 2014; Morgan et al., 2012). I used a nonexperimental design to determine if relationships existed between the independent variable (time exposed to testosterone replacement therapy) and the two dependent variables (quality of life and depression).

I used a repeated measures analysis of variance (rANOVA) design with within-subject effects (Creswell, 2014; Guo et al., 2013). rANOVA is a statistical method utilized by researchers to analyze the equality of means across variables that are fabricated with repeated observation (Creswell, 2014; Guo et al., 2013; Morgan et al., 2012). One advantage of using a rANOVA is that it involves the same participants, which means a smaller sample size is acceptable (Guo et al., 2013; Morgan et al., 2012). The intent and purpose of this rANOVA was to evaluate and see how each of the two dependent variables (quality of life and depression) were affected by the independent variable (time exposed to the testosterone replacement therapy). The independent variable was measured at baseline, 1 month, and 2 months.

I analyzed secondary data from an existing data set. I had no direct contact with the patients included in the data set, which eliminated various ethical issues. Information was collected from a health clinic on the East Coast of the United States. This method of data gathering assured that collected information reflected patients who had low levels of testosterone and began receiving testosterone replacement therapy at the clinic. In chapter

3, I address the research methodology in more detail.

Definitions

Depression: One of the most common mental disorders that results in a constant state of sadness and loss of interest (APA, 2013). The symptoms of depression cause distress in a multitude of environments including occupational, academic, professional, and personal (APA, 2013). Individuals tend to experience an interference with concentration, motivation, and various aspects of daily functioning (APA, 2013). Individuals who experience depression may struggle with typical daily routines and sometimes feel like life is not worth continuing (APA, 2013).

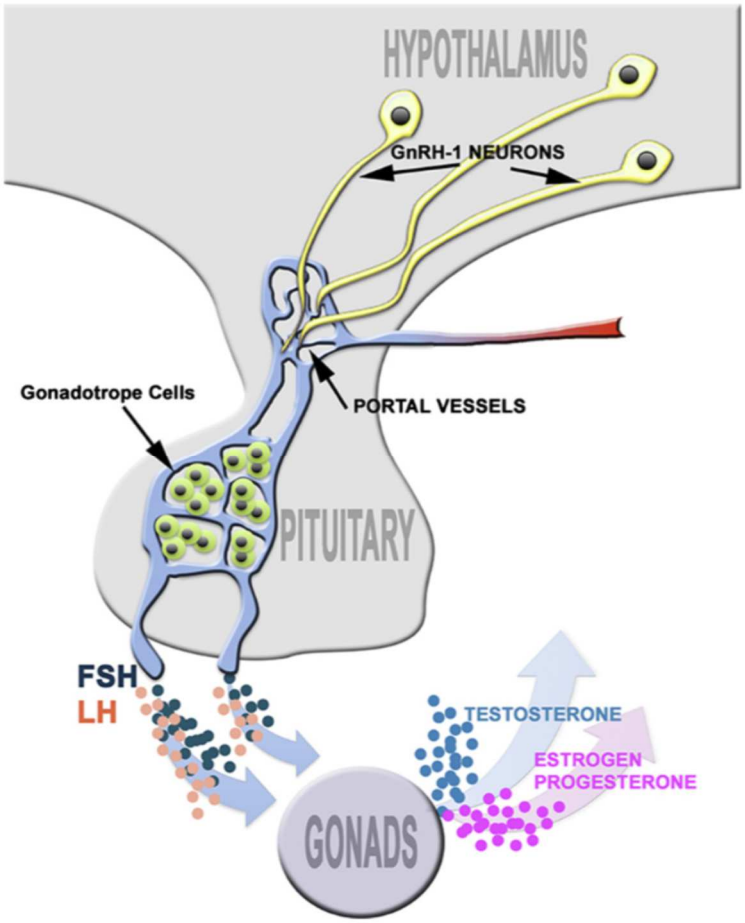
Hypogonadism: A condition that can affect both males and females. For males, this condition occurs when sperm and/or testosterone deficiencies are present at the testicular level and/or from within the hypothalamic-pituitary-testicular axis (Bhasin et al., 2018; Dhindsa et al., 2018; Jung & Shin, 2016; Kim et al., 2016; Lee & Tillman, 2016). Reasons for hypogonadism can be functional or organic in nature (Bhasin et al., 2018). Functional hypogonadism means that there is a possibility to reverse the condition if the underlying cause is properly treated (Bhasin et al., 2018). Organic hypogonadism means that the congenital, structural, genetic, or destructive damage is permanent and not possible to reverse (Bhasin et al., 2018). Hypogonadism can result from trauma to the brain or testicles, chemotherapy, anabolic steroid use, various medications, hormone disorders, and numerous genetic conditions and chronic diseases (Bhasin et al., 2018; Dhindsa et al., 2018; Jung & Shin, 2016; Kim et al., 2016; Lee & Tillman, 2016).

*Quality of Life**:*** A concept consisting of numerous social, biological, physical, environmental, and psychological values (Burckhardt & Anderson, 2003; Gelaye et al., 2016; Nian et al., 2017; Uddin et al., 2017). It is a broad concept that considers how individuals measure components of their subjective well-being (Barton et al., 2016; Cooke et al., 2016; Dronavalli & Thompson, 2015; Gelaye et al., 2016; Shiraishi et al., 2014).

Secondary Hypogonadism: This type of hypogonadism also referred to as hypogonadotropic or central, describes low testosterone as being due to a malfunctioning or damaged hypothalamus or pituitary gland (Barton et al., 2016; Dhindsa et al., 2018; Lasaite et al., 2016; Resnick et al., 2017; Shiraishi et al., 2014). As shown in Figure 2, the hypothalamus produces the gonadotropin-releasing hormone (GnRH), which then prompts the pituitary gland to produce the follicle-stimulating hormone (FSH) and the luteinizing hormone (LH; Aydogan et al., 2012; Bhasin et al., 2010; Forni & Wray, 2015; Livadas & Chrousos, 2020; Morales et al., 2015). The LH then cues the testes to create testosterone (Basaria, 2014; Forni & Wray, 2015; Morales et al., 2015; Sterling et al., 2015).

Figure 2

Hypothalamic-Pituitary-Gonadal (HPG) Axis



Note. The hypothalamus creates GnRH, which triggers the pituitary gland to create FSH and LH. From "GnRH, Anosmia, and Hypogonadotropic Hypogonadism: Where Are We?" by P. Forni and S. Wray, 2015, *Frontiers in Neuroendocrinology, 36*(1), p. 166 (http://doi:10.1016/j.yfrne.2014.09.004). Copyright 2015 by Forni and Wray. Reprinted with permission (see Appendix A).

Testosterone: A hormone found in both males and females that is produced in the gonads (testes for males and ovaries for females) (Incze & Kompala, 2020; Snyder et al., 2016). Males produce a much higher quantity than females (Incze & Kompala, 2020). Males can range from under 20 to over 1,000 nanograms per deciliter (ng/dL), while the range falls between 10 and 80 ng/dL for a female (Jung & Shin, 2016; Snyder et al., 2016).

Testosterone Replacement Therapy: An option for men with secondary hypogonadism (low testosterone), to get their testosterone levels within a generally accepted normal range (250-950ng/dL Nian et al., 2017; Saad et al., 2016; Shin et al., 2016; Tsametis & Isidori, 2018). The primary options for administration include intramuscular, transdermal, and subcutaneous (Lee & Tillman, 2016; Nian et al., 2017; Ponce et al., 2018). Intramuscular administration is a method used to inject the testosterone into the client's muscle (Lee & Tillman, 2016). Advantages include the reasonable cost and ability for patients to learn how to administer the shot themselves (Lee & Tillman, 2016). Disadvantages include possible intermediate changes in mood, soreness, and bruising (Lee & Tillman, 2016). Transdermal administration is a method using patches, gels, or liquids to distribute the testosterone (Hadgraft & Lane, 2015; Lee & Tillman, 2016). Advantages include a less invasive method for administration while disadvantages include daily administration and restrictions when around water, women, and children (Hadgraft & Lane, 2015; Lee & Tillman, 2016).

Subcutaneous administration is a method where testosterone is either injected into a layer of fat below the dermis twice a week, or pellets are implanted into the buttocks

every 3 to 6 months (Lee & Tillman, 2016; Spratt et al., 2017). With the injections, advantages include less discomfort and pain, smaller needle size, possibly fewer dosages of testosterone needed to sustain steady state levels of serum testosterone, and a closer ability to mimic how the body would naturally create testosterone (Lee & Tillman, 2016; Spratt et al., 2017). Disadvantages include more frequent injections. With the pellets, advantages include a slower release and less frequent administration cycles, while the disadvantages include its invasiveness, a possibility for infection, and possible extrusion (Lee & Tillman, 2016; Spratt et al., 2017).

Assumptions

I assumed that the patients in the study were taking testosterone as prescribed for their diagnosis of secondary hypogonadism, and that the prescriptions were of adequate strength. I also assumed that all gathered data were preexisting data from the health clinic. It was assumed that patients in the secondary data set met the inclusion criteria for this study. Another assumption was that the patients filled out the forms and self-reports accurately. It was also assumed all records were as accurate as possible, extending from the assumption that all staff members involved with collecting data had the clinical knowledge and competency to do so. Furthermore, I assumed that the patients had no other comorbidities that could have potentially affected the dependent variables of depression or quality of life. I also assumed that confidentiality and Health Insurance Portability and Accountability Act of 1996 rights were maintained by the use of preexisting data and that the use of these data mitigated potential ethical concerns.

Scopes and Delimitations

In this study I analyzed the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. I chose this topic for this study because only limited research reports were available regarding the psychological effects of testosterone replacement therapy for males with secondary hypogonadism (Barton et al., 2016; Morales et al., 2015; Snyder et al, 2018). The research gap revealed age as an area of neglect, with the available research primarily focused on the aging male population and late-onset hypogonadism (Busnelli et al., 2017; Dudek et al., 2017; Hackett, 2016; Konaka et al., 2016; Lee & Tillman, 2016; McCullough, 2015; Nian et al., 2017; Saad et al., 2016; Snyder et al., 2016; Sterling et al., 2015). I addressed this gap in the literature by focusing on males under the age of 50.

Delimitations also existed within this study. The first delimitation was the age constraint. I was only interested in patients 49 years-of-age and younger. Anyone 50 years of age or older, was excluded from the research. The second delimitation was gender. I took into account and only analyzed biological males; no females or individuals who identify as transgender were included in the research. The third delimitation was the diagnosis of low testosterone. My interest was in males who had been diagnosed with secondary hypogonadism; any clients diagnosed with primary hypogonadism were excluded. The fourth delimitation involved the dependent variables; I only looked at the psychological effects of depression and quality of life. Additional psychological effects such as mood, aggression, anxiety, and irritability were not analyzed. The final delimitation was the route of delivery for the testosterone. Patients at the health clinic

received testosterone by subcutaneous means, meaning that all other routes of delivery (e.g., transdermal, intramuscular, and oral) were excluded from analysis.

Limitations

Although this research was carefully thought out and executed, certain limitations and shortcomings were unavoidable. Primary limitations involved time, access to populations of interest, and use of secondary data. First, I only considered a 2-month period; more accurate results may have been gathered if participants were analyzed for a year or longer. Second, I did not have the opportunity or ability to access all populations of interest. The representative sample was small and may not represent the majority of males under the age of 50 with secondary hypogonadism on a global level. Third, as Frankfort-Nachmias et al. (2015) point out, using secondary data is also considered a limitation. The reason is that the researcher is unable to control how the data are gathered, generated, and recorded (Frankfort-Nachmias, Nachmias, & DeWaard, 2015). Relying on other individuals to accurately gather information introduces many uncertainties, which may be a limitation to this study's validity (see Frankfort-Nachmias et al., 2015).

Significance

This study provides an original contribution to the existing literature by infusing new empirical material that addresses the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. In this way, the study provides a deeper understanding of male hypogonadism from a psychological perspective. This research may prove significant not only to the plethora of

individuals who suffer from low testosterone but also to the clinicians and providers who engage and assist with this population.

This study also challenged the misconception that low testosterone exclusively correlates with age (see Aydogan et al., 2012; Basaria, 2014; McCullough, 2015). Low testosterone is more than a naturally occurring phenomenon that occurs within the aging male population (Lee & Tillman, 2016; McCullough, 2015; Nian et al., 2017; Snyder et al., 2016). This research highlights an existing population of younger males who acquired hypogonadism due to malfunctions of the pituitary gland or hypothalamus (Dudek et al., 2017; Forni & Wray, 2015; Lee & Tillman, 2016). These malfunctions are derived from a variety of issues, including severe stress, drug use, long-term medical diseases, or traumatic brain injuries (Barton et al., 2015; Bhasin et al., 2018; Dhindsa et al., 2018; Forni & Wray, 2015; Issacs & Thomas, 2015; Javed et al., 2015; Lasaite et al., 2016; McCullough, 2015). I plan to share these findings through various publications and conferences, as well as within my professional network.

Several implications for positive social change exist within this study. Current research about testosterone replacement therapy tends to ignore its psychological benefits (Hackett, 2016; Hwang & Miner, 2015; Morales et al., 2015; Yassin et al., 2016). Psychological benefits may include, but are not limited to, decreased depressive symptoms, increased symptoms of well-being, and increased longevity (Morales et al., 2015; Shin et al., 2016; Shiraishi et al., 2014; Snyder et al., 2016; Yassin et al., 2016). With more knowledge about the psychological benefits of testosterone replacement therapy, individuals may be better informed when deciding whether or not testosterone

replacement therapy is an appropriate decision.

This research brings awareness to psychologists of a medical issue that mimics symptoms of depression, anxiety, and various other *DSM-5* diagnoses (Issacs & Thomas, 2015; Kim et al., 2016; Lee & Tillman, 2016; Samahy et al., 2021; Veras & Nardi, 2010). This research also brings awareness to neuropsychologists of a medical issue that can result from traumatic brain injury or mimic its symptoms (Issacs & Thomas, 2015; Sterling et al., 2015; Tanriverdi et al., 2015). Low testosterone can affect males of any age (Aydogan et al., 2012; Basaria, 2014; Busnelli et al., 2017; Huo et al., 2016; Jung & Shin, 2016). It is important for psychologists and neuropsychologists to keep in mind the relevance of a patient's medical history before considering a diagnosis (Issacs & Thomas, 2015; Lee & Tillman, 2016). Education and awareness of low testosterone issues allows for increased accuracy of diagnoses (Issacs & Thomas, 2015; Lee & Tillman, 2016).

Summary

Secondary hypogonadism is a concerning issue for males caused by complications with the hypothalamus or pituitary gland (Akturk & Nippolt, 2016; Dudek et al., 2017; Tarnutzer, 2015). Treatment options are available for hypogonadism, which can affect various psychological features of an individual's life (Akturk & Nippolt, 2016; Izzo, 2016; Lasaite et al., 2016; Shiraishi et al., 2014). In this chapter I provided a brief description of the biopsychosocial model as the theoretical framework for this study. I also introduced the independent and dependent variables and explained how they intertwine with one another. The independent variable, time exposed to testosterone replacement therapy, psychologically affects the dependent variables of depression and

quality of life, according to researchers (Akturk & Nippolt, 2016; Izzo, 2016; Lasaite et al., 2016; Shiraishi et al., 2014). Material presented in Chapter 1 indicated the existence of a gap in the literature and the intention and nature of this study. This study contributes to the scholarly field of psychology by addressing the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. In Chapter 2, I provide a more comprehensive and exhaustive reflection of the available literature relating to testosterone replacement therapy for those with hypogonadism. I also address inconsistencies and gaps in the extant literature concerning the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism.

Chapter 2: Literature Review

Introduction

For a typical male, the mean range of testosterone falls somewhere between 250 and 950 ng/dL (Morales et al., 2015; Saad et al., 2016; Sterling et al., 2015). If the testosterone levels become too low, males of any age may experience various combinations of negative sexual, somatic, and/or psychological symptoms (Akturk & Nippolt, 2016; Aydogan et al., 2012; Lee & Tillman, 2016; Huo et al., 2016). The purpose of this study was to go beyond the confines of the current literature and investigate the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism over a 2-month period. The focus was on determining if a relationship existed between the time exposed to testosterone replacement therapy and levels of quality of life and depression.

The literature review that follows includes information from the most current research relating to psychological effects of testosterone replacement therapy for males under the age of 50 who have been diagnosed with secondary hypogonadism. I describe the literature search strategy and theoretical foundation before reviewing literature on the key variables and concepts involved in the study. The chapter concludes with a concise summary of (a) the major themes found in the literature, (b) what is known and not known in relation to the psychological effects of testosterone replacement therapy for males under the age of 50 who have been diagnosed with secondary hypogonadism, and (c) how the current study addresses and fills a gap in the literature and extends knowledge in the discipline.

Literature Search Strategy

To explore the literature, I used library resources from Walden University, University of Phoenix, Oxford University, and University of California-Berkeley. The specific databases and search engines used to discover the literature included: ASSIA, BioMed Central, Directory of Open Access Journals, EBSCOhost, Embase, ERIC, Google Scholar, ORA, Ovid Medline, Oxford Academic, Oxford Scholarship Online, ProQuest Central, ProQuest Health & Medical, ProQuest Psychology, PsycARTICLES, PsycEXTRA, PsycINFO, PsycNET, PubMed, SAGE Journals, SAGE Knowledge, SAGE Premier, SCOPUS, SOLO, and ZETOC. Types of scholarly literature that were reviewed included systematic reviews, review articles, empirical studies, retrospective studies, prospective trials, meta-analyses, and peer-reviews. Research analysis included recent and past peer-reviewed articles and seminal literature. The following key words, terms, and phrases were used in a variety of combinations: *Testosterone, hypogonadism, hypogonadotropic hypogonadism, testosterone replacement therapy, traumatic brain injury, depression, quality of life, Patient Health Questionnaire, Quality of Life Scale, and biopsychosocial.* The exhaustive list can be found in Appendix B.

Theoretical Foundation

The theoretical framework and foundation for this study was George Engel's (1977) biopsychosocial model which addresses the integration of the biological, psychological, and social aspects of a client's life. As Wade and Halligan (2017) pointed out, the biopsychosocial model provides validity and utility to a generally accepted view that health is based on an amalgamation of multiple factors. Babolola et al. (2017), along

with Moss (2018), have noted that the biopsychosocial model allows for a more integrative cognizance of the biological, psychological, and social elements of an individuals' life. The World Health Organization has endorsed the biopsychosocial approach and its methods for understanding mental health concerns in an inclusive manner (Babolola et al., 2017; Moss, 2018; Wade & Halligan, 2017).

A number of researchers (e.g., Babalola et al., 2017; Guillemin & Barnard, 2015; Gupta & Venkatesan, 2018; Register-Mihalik et al., 2020; Wade & Halligan, 2017) have used the biopsychosocial model. Some researchers have analyzed how the model assists when working with psychological concerns such as depression or anxiety (Ell et al., 2015; Moss, 2018). Ell et al. (2015) explored the use of the model for patients displaying symptoms of depression. Moss (2018) utilized the biopsychosocial approach to show efficacy in treating anxiety. Some researchers have suggested that a biopsychosocial approach enhances and increases overall health outcomes (Ell et al., 2015; Wade & Halligan, 2017). Other researchers have demonstrated how the biopsychosocial model can assist in explaining concerns and how complications can span more than one aspect of a client's life (Iliffe, 2017; Vongas & Alhaji, 2015). Iliffe (2017) used the framework to explain how dementia affects the biological, psychological, and social aspects of a client's life. Vongas and Alhaji (2015) used the framework to explain how testosterone levels affect a client biologically, psychologically, and socially.

The biopsychosocial model stems from the view of a client's health being affected by three different aspects (Benning, 2015; Engel, 1977; Gupta & Venkatesan, 2018; Kusnanto et al., 2018). As Iliffe (2017) suggested, looking at the biological, social, and

psychological concerns assists clinicians in administering a more thorough and case-specific treatment. When working from a biopsychosocial approach, a clinician explores the three aspects (biological, psychological, and social) of the individual's life, taking into account micro and the macro perspectives (Iliffe, 2017; Jorn, 2015). As Kusnanto et al. (2018) suggested, the biopsychosocial model potentially provides a more accurate diagnosis due to the understanding and awareness of the intertwinement of biological, psychological, and social components. The biopsychosocial framework can provide a fundamental route to integrate mental and physical concerns (Melchert, 2011; Pletikosic et al., 2018; Richter, 1999). The model helps to explain why physiological issues can sometimes create psychological complications (Wade & Halligan, 2017). Furthermore, it takes into account a client's history and symptoms in the context of various life circumstances and can support a treatment that is multifaceted in nature (Benning, 2015; Engel, 1977; Kusnanto et al., 2018; Vongas & Alhaji, 2015).

Literature Review of Key Variables and Concepts

Hypogonadism

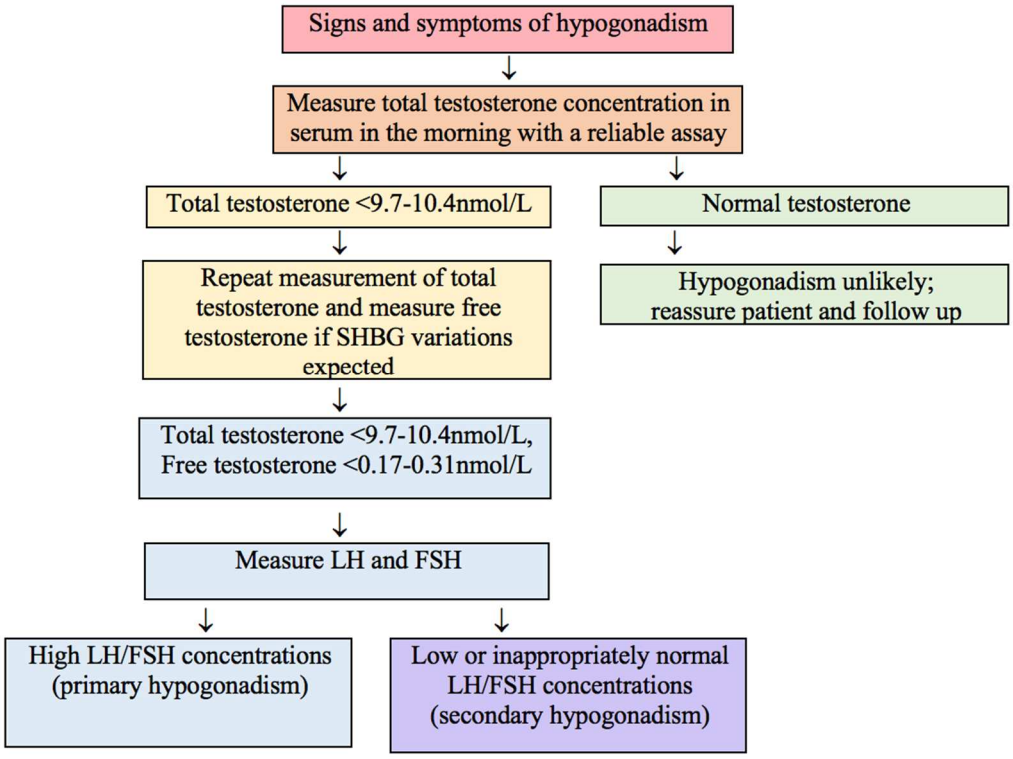
The majority of research in the literature review, focuses on hypogonadism, also known as low testosterone, and how it affects the aging male population (e.g., Dudek et al., 2017; Nian et al., 2017; Snyder et al., 2016; Sterling et al., 2015). Yet, age is not a deterrent for hypogonadism; anyone of any age can be affected (Aydogan et al., 2012; Travis, 2015; Sterling et al., 2015). Hypogonadism can begin while a fetus is still in the womb, during childhood, adolescence, or adulthood (Lee & Tillman, 2016; Morales et al., 2015; Sterling et al., 2015).

Recognized as an important condition since the early 1940s, hypogonadism is broadly defined as a condition where the testicles do not create an adequate amount of testosterone (Dhindsa et al., 2018; George et al., 2017; Kim et al., 2016). Hypogonadism is now a well-recognized, medical condition that is known to negatively affect general health, mental health, sexuality, reproduction, and quality of life (George et al., 2017; Rosen et al., 2018). Sterling et al. (2015) pointed out that nearly four million men in the United States are affected by hypogonadism. The definition of hypogonadism has a variety of sub-classifications based on the age of the individual and the source (Bhasin et al., 2018; Sterling et al., 2015). For example, hypogonadism sources include: aging, issues with the thyroid, chemotherapy, and genetic morphing of certain genes (Bhasin et al., 2018; Snyder et al., 2018). As Akturk et al. (2016) pointed out, failing to identify the underlying cause of hypogonadism can create further issues and complications.

Hypogonadism is easy to define but tricky to diagnose (see Figure 3); in addition, treatment is controversial (Bhasin et al., 2018; McBride et al., 2017; Morales et al., 2015; Sterling et al., 2015; Varimo et al., 2017). Experts have posited two categories of hypogonadism (primary and/or secondary); it is essential to determine which category of hypogonadism a client falls under (Akturk et al., 2016; Bhasin et al., 2018; Lee & Tillman, 2016; Morales et al., 2015). A client could fall under one category or both, depending on the circumstances (Akturk et al., 2016; Bhasin et al., 2018; Lee & Tillman, 2016; Morales et al., 2015; Sterling et al., 2015). Either type of hypogonadism may be labeled congenital or acquired (Akturk et al., 2016; Bhasin et al., 2018; Dwyer et al., 2019; Lee & Tillman, 2016; Morales et al., 2015; Sterling et al., 2015).

Figure 3

Diagnosis of Male Hypogonadism



Note. SHBG = sex hormone binding globulin. LH = luteinizing hormone. FSH = follicle stimulating hormone. From "Male Hypogonadism," by S. Basaria, 2014, *Lancet, 383*(1), p. 1253 (https://doi:10.1016/S0140-6736(13) 61126-5). Copyright 2014 by S. Basaria.

Common symptoms of low testosterone include: decreased sex drive, increased body fat, erectile dysfunction, complications with memory and/or concentration, decreased amounts of body hair, increased moodiness and/or irritability, decreased muscle mass, osteoporosis, decreased sense of well-being, and depression (Anderson et al., 2016; Aydogan et al., 2012; Cherrier et al., 2015; Dhindsa et al., 2018; Elliott et al.,

2017; Izzo et al., 2016; Ivanov et al., 2018). Due to the known correlation between a male's age increasing and testosterone levels naturally decreasing, the majority of hypogonadism research focuses on the older male and aging population (Resnick et al., 2017; Saad et al., 2016; Shin et al., 2016; Snyder et al., 2016; Winters & Huhtaniemi, 2017). One of the primary concerns with hypogonadism is the frequency in which it is often underdiagnosed or misdiagnosed as another condition (Issacs & Thomas, 2015; Lee & Tillman, 2016; Silva et al., 2015; Tanriverdi & Kelestimur, 2015).

Secondary Hypogonadism

Secondary hypogonadism, also referred to as hypogonadotropic or central hypogonadism, reveals that low testosterone is due to a malfunctioning or damaged hypothalamus or pituitary gland (Barton et al., 2016; Dhindsa et al., 2018; Plessis et al., 2019). The hypothalamus produces the gonadotropin-releasing hormone, which then prompts the pituitary gland to produce the follicle-stimulating hormone (FSH) and the luteinizing hormone (LH) (Aydogan et al., 2012; Bhasin et al., 2010; Morales et al., 2015). The LH then cues the testes to create testosterone (Morales et al., 2015; Sterling et al., 2015). Conditions and circumstances that cause secondary hypogonadism include: genetic defects, severe stress, drug use, long-term medical diseases, or damage to the hypothalamus or pituitary gland (Bhasin et al., 2018; Dhindsa et al., 2018; Forni & Wray, 2015; Issacs & Geracioti, 2015; Lasaite et al., 2016; McCullough, 2015).

Some of the literature addresses the increasing awareness and connection between traumatic brain injuries and secondary hypogonadism (e.g. Barton et al., 2016; Issacs & Thomas, 2015; Izzo et al., 2016; Javed et al., 2015; Reifschneider et al., 2015; Silva et al.,

2015; Tan et al., 2017; Tanriverdi & Kelestimur, 2015; Tanriverdi et al., 2015; Tritos, 2015). Traumatic brain injuries as Hackenberg and Unterberg (2016) reported, are the number one cause of long-term disability for young adults. As Silva et al. (2015) and Tanriverdi et al. (2015) pointed out, hypogonadism following a traumatic brain injury is more prevalent than previously thought. Izzo et al. (2016) concurred with Silva et al. (2015) and Tanriverdi et al. (2015) by reporting that hypogonadism occurs in up to half of all clients who sustain a traumatic brain injury. Barton et al. (2016) and Javed et al. (2015) also suggested that those with traumatic brain injuries are at a high risk for developing secondary hypogonadism.

A significant portion of the literature examining secondary hypogonadism covers the topics of common symptoms and how to properly diagnose (Dhindsa et al., 2018; Dudek et al., 2017; Sterling et al., 2015; Tarnutzer et al., 2015). Typical symptoms of low testosterone include changes in sexual functions, sleeping patterns, physical changes, and emotional changes (Akturk & Nippolt, 2016; Aydogan et al., 2012; Gray et al., 2017; Huo et al., 2016; Hwang & Miner, 2015; Javed et al., 2015). Within these broader categories of change, one could see a lower sex drive, irritability, fatigue, body hair loss, depression, and an overall lower quality of life (Akturk & Nippolt, 2016; Aydogan et al., 2012; Huo et al., 2016; Hwang & Miner, 2015; Javed et al., 2015). Professionals agree that when diagnosing hypogonadism, attention must be paid to LH and FSH levels (Basaria, 2014; Bhasin et al., 2010; Forni & Wray, 2015; Yazdani & Branch, 2018).

Testosterone Replacement Therapy

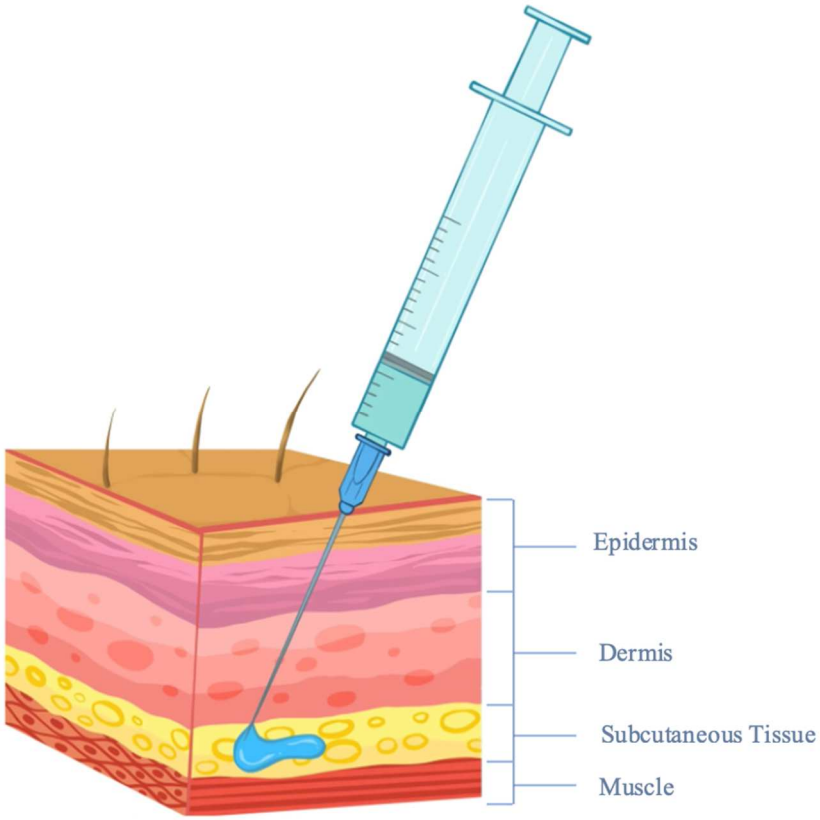
The goal of testosterone replacement therapy is to bring the insufficient testosterone level of the individual back within the designated acceptable range (Gabrielsen et al., 2016; Khandwala et al., 2018; Layton et al., 2017; Sehn et al., 2018; Shoskes et al., 2016; Straftis & Gray, 2019). A search through scholarly journals turned up a variety of articles addressing the history of testosterone replacement therapy (Anderson et al., 2016; George et al., 2017; Hwang & Miner, 2015; Khandwala et al., 2018; Lasaite et al., 2016; Sehn et al., 2018; Wynia & Kaminetsky, 2015; Yassin et al., 2016; Yazdani & Branch, 2018). Research has continued to present an array of materials that suggest potential beneficial results of testosterone replacement therapy somatically, sexually, and psychologically speaking (Anaissie et al., 2017; Anderson et al., 2016; Elliott et al., 2017; Kapoor, 2016; Morales et al., 2015; Ponce et al., 2018; Saad, Aversa, et al., 2011; Wynia & Kaminetsky, 2015; Yazdani & Branch, 2018).

The current routes of testosterone replacement delivery available include: transbuccal (through the cheek), oral (through the mouth), intranasal (through the nose), intramuscular (through the muscle), transdermal (through the skin), and subcutaneous (through the fat), with the last three considered the primary and most popular options (Lee & Tillman, 2016; Mintzes, 2018; Spratt et al., 2017; Wynia & Kaminetsky, 2015). Intramuscular indicates that the testosterone is injected with a needle into a vascular muscle, typically the deltoid, vastus lateralis, or gluteal regions (Wynia & Kaminetsky, 2015). Transdermal involves a patch, gel, or solution of testosterone being placed on the surface of the skin (Wynia & Kaminetsky, 2015). Subcutaneous administration includes

both shots that are injected or pellets that are implanted. Shots or pellets are both administered into a layer of fat under the surface of the skin (see Figure 4; Spratt et al., 2017; Wynia & Kaminetsky, 2015).

Figure 4

Subcutaneous Injection of Testosterone



Note. The subcutaneous tissue layer is composed of fatty tissue located directly under the dermis of the skin. (K. Davis, personal communication, May 14, 2021). Reprinted with permission (see Appendix A).

After decades of testosterone replacement therapy research, substantial evidence has indicated that low levels of testosterone are associated with increased cardiovascular risks, while higher levels of testosterone are associated with decreased cardiovascular risks (Alexander et al., 2017; Corona et al., 2016; George et al., 2017; Jasuja et al., 2017; Jasuja & Rose, 2017; Lunenfeld et al., 2015; Morgentaler et al., 2016; Mullhall et al., 2018). Of the hundreds of studies, a total of four indicated an increase in cardiovascular risks; two of these were flawed retrospective studies (Finkle et al., 2014; Vigen et al., 2013), one was a prospective trial with a few findings (Basaria et al., 2010), and another one was a meta-analysis that reported results of questionable clinical significance (Xu, Freeman, Cowling, & Schooling, 2013).

The majority of articles discuss testosterone replacement therapy in older men (Bhasin et al., 2010; Busnelli et al., 2017; Cherrier et al., 2015; Giuseppe et al., 2020; Hackett, 2016; Huo et al., 2016; Jung & Shin, 2016; Kim et al., 2016; Konaka et al., 2016; Lee & Tillman, 2016; McCullough, 2015; Morales et al., 2015; Nian et al., 2016; Plessis et al., 2019; Saad et al., 2016; Shin et al., 2016; Snyder et al., 2018). Huo et al. (2016) performed a systematic review of 156 journal articles, with the focus on testosterone replacement therapy for older individuals with cardiovascular disease. The results of the studies appeared to be inconsistent; some reported the clinical effects favoring testosterone therapy, while others reported the clinical effects favoring the placebo (Huo et al., 2016; Mullhall et al., 2018). Looking specifically at the treatment of testosterone replacement therapy for depression, Huo et al. (2016) also reported inconsistent and mixed findings. In alignment with the findings of Huo et al, Ponce et al.

(2018) reported that the safety and efficacy of testosterone replacement therapy in men with hypogonadism continues to remain insufficiently understood.

Ponce et al. (2018) and Yassin et al. (2016) looked at some of the physiological effects of long-term testosterone replacement therapy, primarily erectile functioning, body weight, and metabolic parameters. According to the majority of researchers, testosterone replacement therapy is effective for increasing erectile functions and bone mineral density, while decreasing fat mass (George et al., 2017; Morgentaler et al., 2016; Ponce et al., 2018).

The Morgentaler et al. (2016) article stood out; it was written by members of a panel of international experts comprised of urologists, endocrinologists, internal medicine specialists, and scientific researchers. The conference of experts represented 4 continents and 11 countries (Morgentaler et al., 2016). The panel discussed hypogonadism and testosterone replacement therapy, and came to a unanimous conclusion on nine key points advocating: (a) hypogonadism is a concern on a global scale, (b) there is no scientific basis for any type of age-related suggestions against utilizing testosterone replacement therapy in men, (c) there is a lack of evidence to support increased cardiovascular risk or prostate cancer, and (d) testosterone replacement therapy for males with hypogonadism is effective and evidence-based (Morgentaler et al., 2016).

How Testosterone Replacement Therapy Affects Depression

When analyzing the results of scholarly studies, inconsistencies appeared; some researchers reported that testosterone replacement therapy has an effect on levels of depression, while others reported the opposite (Aydogan et al., 2012; Basaria, 2014;

Bhasin et al., 2010; Cherrier et al., 2016; Hwang & Miner, 2015; Jung & Shin, 2016; Lasaite et al., 2016; Lee & Tillman, 2016; Morales et al., 2015; Ponce et al., 2018; Shin et al., 2016; Snyder, 2016). Aydogan et al. (2012), Basaria (2014), Cherrier et al. (2015), Lasaite et al. (2016), Lee and Tillman (2016), and Snyder et al. (2016) found testosterone replacement therapy as having varying degrees of efficacy on levels of depression. Cherrier et al. and Lasaite et al. were the only researchers to describe the effects of testosterone replacement therapy on depression as significant and substantial. Aydogan et al., Basaria et al., and Lee and Tillman, reported observable improvements in levels of depression, post testosterone therapy treatments. Snyder reported small-to-moderate degrees of improvements with measuring levels of depression, when testosterone therapy treatments increased from a moderate/low range to a mid/normal range. Bhasin et al., Huo et al., (2016) and Jung and Shin reported inconsistent effects of testosterone replacement therapy on depression.

Only a handful of the scholarly literature returned results analyzing males under the age of 50 (Aydogan et al., 2012; Huo et al., 2016; Lasaite et al., 2016). Aydogan et al. (2012) acknowledged depression as being one of the most common psychopathological conditions in young males with hypogonadism. The Aydogan et al. study analyzed 40 males with congenital secondary hypogonadism whose average age was 23.42. The findings indicated that males with lower levels of testosterone might display increased negative psychological symptoms like depression (Aydogan et al., 2012). Huo et al. (2016) performed a systematic review of 156 papers spanning 65+ years of research; a small number of those papers analyzed males under the age of 50, or whose mean age

was under 50. Huo et al. reported for those males, inconsistent findings when treating depression with testosterone replacement therapy. Lasaite et al. (2016) looked at young and middle-aged males with hypogonadism, whose mean age was 30.5. Lasaite et al. indicated that testosterone replacement therapy appeared to have a beneficial effect on depression scores.

How Testosterone Replacement Therapy Affects Quality of Life

The results of the literature appear to be inconsistent; some researchers reported testosterone replacement therapy as effecting quality of life positively, while others reported the opposite (Aydogan et al., 2012; Basaria, 2014; Bhasin, 2010; Konaka et al., 2016; Lasaite et al., 2016; Morales et al., 2015; Morgentaler et al., 2016; Nian et al., 2017; Ponce et al., 2018; Shiraishi et al., 2014). Aydogan et al. (2012), Bhasin et al. (2010), Morgentaler et al. (2016), and Shiraishi et al. (2014) found general improvements in the quality of life scores following testosterone replacement therapy. Cherrier et al. (2015), Huo et al. (2016), and Lasaite et al. (2016), indicated that they found no significant changes or beneficial effects of testosterone replacement therapy on quality of life scores. Basaria (2014) took neutral ground reporting the role of testosterone replacement therapy on quality of life remains unclear due to the results of the various trials conflicting with one another.

Only a handful of the scholarly literature reported results after studying males under the age of 50 (Aydogan et al., 2012; Huo et al., 2016; Lasaite et al., 2016; and Shiraishi et al., 2014). Aydogan et al. (2012), who reported observable improvements in the quality of life scores, analyzed 40 males with congenital secondary hypogonadism,

whose average age was 23.42. Huo et al. (2016) utilized a handful of papers stemming from a systematic review that analyzed males under the age of 50, or whose mean age was under 50. Huo et al. reported testosterone replacement therapy as having no effect on an individual's quality of life. Lasaite et al. (2016) indicated no beneficial effects in an individual's quality of life. Lasaite et al. also disclosed the full effects of testosterone replacement therapy for young, hypogonadal, adult males have yet to be fully evaluated. Shiraishi et al. (2014) analyzed hypogonadal males whose Mean was 26.1. Shiraishi et al. associated testosterone replacement therapy with significant improvements for those with secondary hypogonadism.

Summary

In this chapter, I provided an exhaustive review of the literature on the research topic of psychological effects of testosterone replacement therapy for males under the age of 50, with secondary hypogonadism. I also introduced a detailed analysis of the biopsychosocial model as the theoretical framework was also explored within this chapter and how it connected to the biomedical variable of time exposed to testosterone replacement therapy with the psychosocial variables of depression and quality of life. In this chapter, I provided the key variables and concepts of hypogonadism, secondary hypogonadism, and testosterone replacement therapy. I also discussed major themes present in the literature including how testosterone replacement therapy affects depression and quality of life. In this chapter, I provided a summary of what is well known versus what is not known in relation to the topic of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. I also explored the

inconsistencies and gaps in the literature surrounding how testosterone replacement therapy affects or does not affect levels of depression and the quality of life. In this chapter I also offered an explanation for extending knowledge of medical concerns that present as psychological symptoms into the field of clinical psychology. In Chapter 3, I provide detailed descriptions and justifications for the selected research methods utilized in the current study.

Chapter 3: Research Methodology

Introduction

The purpose of this quantitative study was to investigate the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism over a 2-month period. The independent variable was time exposed to testosterone replacement therapy, while the dependent variables were quality of life and depression. The patients in this study were required to have a diagnosis of low testosterone and have a recommendation of testosterone replacement therapy from their medical doctor. I gathered all data for this study from an existing, archived data set. No direct communication occurred between myself and the patients.

In Chapter 3, I describe the research methodology that I used in this study. A brief review of the design and rationale of the study, including the setting and sampling procedures; procedures for recruitment, participation and data collection; and instrumentation, is also presented. The data analysis plan is explored, including RQs, hypotheses, and statistical tests. Additionally, threats to external, internal, and construct validity, including reliability of the instrument, data assumptions, sample size, and the measures taken to protect the rights of the participants are presented. Finally, I describe ethical procedures and concerns related to this study.

Research Design and Rationale

I conducted this study using a quantitative, non-experimental design. According to Creswell (2014), a quantitative approach offers researchers a chance to work with data from various sample sizes and generalize about larger populations. Creswell suggested a

quantitative design is a sufficient approach when determining if a relationship exists between variables or when evaluating various theories. The primary goal of this nonexperimental design was to determine whether or not a relationship existed between the independent variable and the dependent variables.

I analyzed the association between time exposed to testosterone replacement therapy, and the psychological constructs of quality of life and depression. To accomplish this goal, data were gathered from a health clinic and then quantitatively analyzed. I used secondary data, which means the variables were not manipulated or controlled in any way (Creswell, 2014). A sample was drawn from the medical records. Data were then assessed in order to determine whether a relationship existed between time exposed to testosterone replacement therapy and the participants' self-rated scores on depression and quality of life.

Repeated measures (r) is a research design sometimes paired with an analysis of variance (ANOVA), which is a statistical tool. An rANOVA is a statistical method used by researchers to analyze the equality of means across variables that are fabricated with repeated observation (Creswell, 2014; Guo et al., 2013; Morgan et al., 2012). More specifically, I used a one-way rANOVA meaning there was only one independent variable, also known as the within-subjects factor. One of the advantages of using a one-way rANOVA is that it allows for the use of the participants as their own control which decreases variability (Creswell, 2014; Guo et al., 2013; Morgan et al., 2012). The repeated measure design makes it possible to account for the differences and separate them from the treatment and error conditions (Creswell, 2014; Guo et al., 2013; Morgan

et al., 2012). Collecting repeated measurements of variables is also an advantage because it supplies a more definitive assessment of how change occurs within each person over a specific duration of time (Guo et al., 2013; Morgan et al., 2012). The intent and purpose of using a one-way rANOVA was to evaluate and see how each of the two dependent variables (quality of life and depression) were affected by the independent variable (time exposed to the testosterone replacement therapy). The independent variable was measured at baseline, 1 month, and 2 months.

Methodology

Population

The target population for this study was males under the age of 50 who were diagnosed with secondary hypogonadism. I collected secondary data from a health clinic on the East Coast of the United States. The clinic already gathers relevant data relating to the dependent variables of this study (depression and quality of life). The participants in this study were males under the age of 50 who were receiving testosterone replacement therapy for low testosterone in Spring 2021. The general population of individuals with secondary hypogonadism in the United States is estimated to be somewhere between two and four million (Barton et al., 2016; Hohl et al., 2014; Sterling et al., 2015).

Sampling and Sampling Procedures

I used purposive sampling for this study because this particular health clinic collects specific information relevant to this study (specific to out-patient individuals using testosterone replacement therapy), while measuring various symptomatic descriptors. I chose to use this nonprobability technique based on characteristics of the

health clinic (population) and testosterone replacement therapy. Purposive sampling was suitable for this study's variables and RQs, which centered on determining the extent of the relationship between length of exposure to testosterone replacement therapy and depression and quality of life in males under the age of 50 with secondary hypogonadism over a 2-month period.

I analyzed secondary data collected in the Spring of 2021, by a health clinic on the East Coast of the United States. The procedure for gathering the sample involved several measures. First, all participants whose data was analyzed from the clinic received testosterone replacement therapy by subcutaneous injections of testosterone cypionate, USP, which is the oil-soluble 17 (beta)–cyclopentylpropionate ester of the androgenic hormone testosterone (Borodi et al., 2020; Meng et al., 2015; Shoskes et al., 2016; Vogiatzi et al., 2021). The chemical composition of testosterone cypionate, USP is adrost-4-en-3-one, 17-(3-cyclopentyl-1-oxopropoxy)-,(17b)- (Borodi et al., 2020; Meng et al., 2015; Shoskes et al., 2016; Vogiatzi et al., 2021). Each milliliter (mL) of the 200 mg/mL formula includes testosterone cypionate, USP 200 mg, benzyl benzoate, USP 0.25 mL, benzyl alcohol, USP 0.02 mL, and grapeseed oil 0.50 mL (Borodi et al., 2020; Meng et al., 2015; Shoskes et al., 2016; Vogiatzi et al., 2021). Second, the deidentified patient records were provided and included age (history forms), quality of life measurement (questionnaire), depression measurement (questionnaire), the start date of the testosterone replacement therapy (lab results), and testosterone levels measured with a total-testosterone test (lab results). Patients receiving testosterone replacement therapy for primary hypogonadism (hypergonadotropic hypogonadism/testicular failure) were

excluded from the study. All information gathered for this study came from the secondary data meaning there was no direct contact or communication between myself and the patients. The clinic involved with this study is the legal owner of their respective data. Agreements between myself and the provider of the data ensured protection and confidentiality of patient information.

The sample size of a study is typically determined before research begins in order to make sure an adequate number of responses are gathered (Creswell, 2014; Guo et al., 2013). Having a sufficient and adequate sample size ensures that enough data have been gathered to make inferences about a given population (Creswell, 2014; Guo et al., 2013). Selecting an appropriate sample size for studies that utilize repeated measures is crucial when calculating a successful study (Creswell, 2014; Guo et al., 2013). I used G*Power 3.1.9.7 (Faul et al., 2009) with Cohen's f test was used to calculate the sample size for a one-way repeated measures analysis of variance (rANOVA).

Cohen (1982) stated that when a population is limited in size, it is appropriate to set the alpha at .10 or higher. Faul et al. (2009) suggested that the lowest acceptable priori power is .70. With the correlation among repeated measures set at .50, an alpha level of .05, power set at .80, and a confidence level of 95%, an effect size of .40 would be detectable with a sample size of 12. Although the recommended sample size was 12, I drew a larger sample to help decide whether a statistically significant effect existed between the independent and dependent variables. I also used a large effect size to align with various researchers who reported that the impact of testosterone replacement therapy

on various psychological factors was significant or large (Jung & Shin, 2016; Saad, et al., 2011; Zweifel & O'Brien, 1997).

Archival Data

I analyzed secondary data collected in the Spring of 2021, by a health clinic on the East Coast of the United States. At the beginning of the research project process, I made contact with one of the owners of the clinic. The study was introduced, explained, and a request was made to utilize the archival data. Approval was given by the clinic to obtain patient's pertinent records for this study. The procedure for gaining access to the data set involved a data use agreement between the data provider (health clinic) and the data recipient (me). The agreement allowed for limited use of deidentified information for the singular purpose of research. The data use agreement with the health clinic, allowed specified access to a limited, deidentified data set (age, quality of life measurement, depression measurement, the start date of the testosterone replacement therapy, and testosterone levels measured with a total-testosterone test). The health clinic maintained the sole rights to all records needed for this study; therefore, client permission was not required or necessary. Patients were identified by an identification number (1-18), and remained confidential in order to protect all information shared for this study. I input the data into SPSS Version 27 for statistical analysis (Morgan et al., 2012).

Instrumentation and Operationalization of Constructs

Patient Health Questionnaire – 9

I administered the PHQ-9, which is used to operationalize, diagnose, monitor, and measure perceived levels of depression in patients (Chen et al, 2016; Manea et al., 2015;

Mitchell, et al., 2016). Comprised of nine questions, the PHQ-9 is an interval scale, self-administered instrument that incorporates *DSM-5* depression diagnostic criteria (APA, 2013; Munoz-Navarro et al., 2017). The PHQ-9 is an assessment specifically designed to measure levels of depression (Chen et al, 2016; Keum et al., 2018; Munoz-Navarro et al., 2017). The PHQ-9 was developed thanks to an educational grant provided by Pfizer (Kroenke et al., 2001). Permission to use the instrument is not necessary because it is in the public domain.

As Kroenke et al. (2001) pointed out, the PHQ-9 can be repeatedly administered to reflect improvement or worsening of depression in response to treatment. The diagnostic validity of the PHQ-9 was established in various studies involving eight primary care clinics and seven obstetrical clinics (Kroenke et al., 2001). The nine questions specifically refer to the past 2 weeks of a patient's life and how often they have been bothered by problems including: having minimal interest or pleasure in doing things; feeling down, depressed, or hopeless; trouble falling asleep, staying asleep, or sleeping too much; feeling tired or having little energy; having poor appetite or overeating; feeling bad about one's self or that one is a failure or has let one's self or one's family down; difficulty concentrating on things; moving or speaking so slowly that other people could have noticed; being fidgety or restless; moving around a lot more than usual; and thoughts that one would be better off dead or hurting one's self in some way (Kroenke et al., 2001; Mitchell et al., 2016).

The nine questions cover specific depression diagnostic criteria of the *DSM-5* and have three main scoring formats: PHQ-9-linear, PHQ-9-algorithm, and PHQ-2 (APA,

2013; Mitchell et al., 2016). I used the PHQ-9-linear, which is scored with simple addition, and has a sensitivity and specificity of 88% for detecting major depressive disorder (Mitchell et al., 2016). The scoring used a Likert system with four choices that include not at all, several days, more than half the days, or nearly every day (Kroenke et al., 2001).

PHQ-9 scores range from 0–27; the higher the number, the more depressed an individual feels (Kroenke et al., 2001). A score of 0-4 gives a provisional diagnosis of minimal depression (Kroenke et al., 2001). A score of 5-9 gives a provisional diagnosis of mild depression (Kroenke et al., 2001). A score of 10-14 gives a provisional diagnosis of moderate depression (Kroenke et al., 2001). A score of 15-19 gives a provisional diagnosis of moderately severe depression (Kroenke et al., 2001). A score of 20-27 gives a provisional diagnosis of severe depression (Kroenke et al., 2001).

Recent studies indicate that the PHQ-9 is a highly reliable and valid instrument that can be used for screening and measuring depression with a wide variety of populations (Chen et al., 2016; Gelaye et al., 2016; Manea et al., 2015; Mitchell et al., 2016; Munoz-Navarro et al., 2017). Chen et al (2016) used over 600 participants to assess the reliability, validity, and factor structure of the PHQ-9. The results of Chen et al indicated internal consistency ($\alpha = 0.77$), test/retest reliability (0.79), and concurrent validity ($r = 0.66$; $p < 0.001$). Gelaye et al (2016) used almost 1,000 participants to assess the reliability and validity of the PHQ-2, which is one of two subscales of the PHQ-9. The results of Gelaye et al indicated strong construct and criterion validity, which makes the assessment tool attractive and preferred as an extremely brief screening questionnaire.

Manea et al (2015) performed a bivariate meta-analysis of different scoring methods of the PHQ-9. Manea et al indicated that the algorithm method, which tends to miss a significant number of patients with major depressive disorder, leads to low sensitivity (0.55). Manea et al also indicated that the linear standard cut-off method leads to a more acceptable sensitivity (0.77) and maintained a strong specificity (0.85). Mitchell et al (2016) performed a meta-analysis of 40 individual studies and reported sensitivity and specificity for detecting major depressive disorder with the PHQ-9 at 88%. Munoz-Navarro et al (2017) used 178 patients to obtain optimal cut-off values for screening and identifying those suspected to have major depressive disorder. Munoz-Navarro et al indicated an optimal cut-off value of 12 rather than 10, which is the most commonly used cut-off value. Appendix C includes the PHQ-9 in its entirety.

Quality of Life Scale

I also used the QoLS (Burckhardt & Anderson, 2003) to operationalize and measure quality of life in patients. Comprised of 16 items, the QoLS is an interval scale, self-administered instrument that analyzes the quality of life concept (Burckhardt & Anderson, 2003). The QoLS was developed in the 1970s by John Flanagan (Burckhardt & Anderson, 2003; Gupta & Venkatesan, 2018). Permission to use this instrument is not necessary because it is in the public domain.

As Burckhardt and Anderson (2003) pointed out, the reliability, content, and construct validity of the QoLS have been demonstrated in a number of studies. Burckhardt and Anderson also indicate that the QoLS has correlations with physical health standings and disease impact measures that fall between the low and moderate

ranges. Burckhardt and Anderson also highlighted that content validity analysis indicates that the tool accurately measures domains that a wide variety of patient groups define as quality of life. The QoLS is regarded as a valid and reliable instrument for measuring quality of life across various groups and cultures and is conceptually unlike other indicators of quality of life (Burckhardt & Anderson, 2003; Cooke et al., 2016; Dronavalli & Thompson, 2015; Hagg et al., 2003; Uddin et al., 2017).

United States established diagnostic validity in the 1970s with the QoLS using a random sampling of 3,000 adults (Burckhardt & Anderson, 2003). The original scale included 15 items that incorporated five conceptual realms of quality of life (Burckhardt & Anderson, 2003). The five realms cover material and physical well-being; relationships with others; social, community, and civic activities; personal development and fulfillment; and recreation.

In the early 1980s, qualitative research explored individuals with chronic illnesses and their perceptions of quality of life (Burckhardt & Anderson, 2003). After those findings, the QoLS was increased to include one more realm, Independence, or the capability of an individual to do for him or herself (Burckhardt & Anderson, 2003). The QoLS presently consists of 16 items: material comforts, home, food, conveniences, and financial security; health; relationships with parents, siblings and other relatives; having and rearing children; close relationships with spouse or significant other; close friends; helping and encouraging others, volunteering, and giving advice; participating in organizations and public affairs; learning; understanding yourself; work; expressing

yourself creatively; socializing; reading, listening to music, and observing entertainment; participating in active recreation; and independence.

The 16 items are scored utilizing a Likert system with seven choices that include: delighted, pleased, mostly satisfied, mixed, mostly dissatisfied, unhappy, and terrible (Burckhardt & Anderson, 2003). The QoLS has internal consistency (α = .82 to .92) as well as high test-retest reliability in individuals who have been diagnosed with chronic illnesses (r = 0.78 to r = 0 .84) (Burckhardt & Anderson, 2003). Studies indicate that the QoLS is a highly satisfactory instrument that can be utilized for measuring quality of life with a wide variety of populations (Burckhardt & Anderson, 2003; Hägg et al., 2003). QoLS scores range from 16-112, the higher the number, the more satisfied an individual feels (Burckhardt & Anderson, 2003). Average scores for a healthy population are approximately 90 (Burckhardt & Anderson, 2003). Scores for populations with health concerns like post-traumatic stress disorder, psoriasis, or chronic obstructive pulmonary disease, tend to average closer to 80 (Burckhardt & Anderson, 2003). Appendix C includes the QoLS in its entirety.

Data Analysis Plan

I used SPSS Version 27 to analyze the archived depression and quality of life scores of the individuals participating in the current study. The collected data were visually inspected and then SPSS was utilized to address each of the RQs and hypotheses with a one-way rANOVA. Constructing the one-way rANOVA involved measuring and determining the extent of the relationship in which time exposed to testosterone replacement therapy (independent variable) effected depression and the quality of life

(dependent variables). The independent variable was measured at three equal intervals of time. Any participant who did not visit the clinic for all three visits had their information removed from the final analysis. The first measurable period was the baseline or the first time point in which the participants were measured. Participants were not yet exposed to testosterone replacement therapy at the first interval. The second measurable period was month one into the testosterone replacement therapy treatment. Participants had been on testosterone replacement therapy for one month at that point. The third measurable period was two months into the testosterone replacement therapy treatment. This was the final time point in which the participants were measured.

Restatement of the Research Questions and Hypotheses

RQ1: Is the psychological aspect of quality of life significantly affected by testosterone replacement therapy maturation?

$H_0$1: The mean scores for the psychological aspect of quality of life, as assessed by the QoLS, do not differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

H_a1: The mean scores for the psychological aspect of quality of life, as assessed by the QoLS, do differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

RQ2: Is the psychological aspect of depression significantly affected by testosterone replacement therapy maturation?

$H_0$2: The mean scores for the psychological aspect of depression, as assessed by the PHQ-9, do not differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

H_a2: The mean scores for the psychological aspect of depression, as assessed by the PHQ-9, do differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

Assumptions for rANOVAs

Initially, a preliminary exploratory data analysis was conducted to determine if the data met the assumptions of rANOVA, primarily normality and sphericity, and whether or not it was free of outlier scores. When data are analyzed utilizing a one-way rANOVA there are five assumptions to be considered (Verma, 2015). Assumption 1, at least one of the dependent variables must be continuous (Verma, 2015). In this study, both dependent variables (quality of life and depression) were considered continuous (Bowins, 2015; Hankin et al., 2005; Verma, 2015). Assumption 2, the within-subjects factor is considered categorical with at least three levels (Verma, 2015). The within-subjects factor in this study was the independent variable (time exposed to testosterone replacement therapy), which was measured at three different points of time (baseline, 1 month, and 2 months). If either of the first two assumptions would have been violated, an rANOVA would not be the best fit for statistical analysis.

Assumption 3, significant outliers should not exist in any of the levels (Girden, 1991; Verma, 2015). No data points within this study strayed from the typical pattern. Assumption 4, the dependent variables (quality of life and depression) should be within the vicinity of a normal distribution at each measurement (level of the within-subjects factor) (Verma, 2015). Assumption 5, an equality of variance exists between all amalgamations of levels of the within-subjects factor (also known as sphericity) (Verma, 2015). Sphericity is defined as a primary and crucial assumption of rANOVAs (Field, 2018). Sphericity occurs when one looks at all possible pair combinations of the within-subject conditions and sees that the variances are equal (Field, 2018).

The last three assumptions correlate to the inherent nature of the data and are easily examinable utilizing statistical software like SPSS (Verma, 2015; Weinfurt, 2000). Statisticians indicate it not unusual for the collected data to violate one, two, or all three of these final assumptions (Verma, 2015; Weinfurt, 2000). Appropriate actions that could be considered if one or more of the last three assumptions were violated include: correcting the data so it would not fail the assumptions, utilizing a different statistical test, or carrying on with the analysis even though the data fails specific assumptions (Verma, 2015; Weinfurt, 2000).

When violations occur with assumption three, the researcher must decide whether or not to keep the outliers (Bowins, 2015; Hankin et al., 2005; Verma, 2015). The concern with outliers is they can negatively affect the rANOVA by causing distortion differences between the within-subjects factor levels, and cause issues with generalizability (Bowins, 2015; Hankin et al., 2005; Verma, 2015). When violations

occur with assumption four (normality), some leeway is given due to robustness (Verma, 2015). Some violations of normality are acceptable and even then the rANOVA can still provide valid results (Bowins, 2015; Hankin et al., 2005; Verma, 2015). Methods such as the Shapiro-Wilk test for normality are common procedures to test the assumption of normality (Bowins, 2015; Hankin et al., 2005; Verma, 2015). When violations occur with assumption five it can lead to elevated Type I errors, meaning discovering a statistically significant result when one does not exist (Verma, 2015). Tests such as Mauchly's test of sphericity can assist in determining whether or not data has violated the final assumption (Verma, 2015; Weinfurt, 2000).

Threats to Validity

External Validity (Generalizability)

External validity is the extent in which the results of this study are generalizable to other individuals and circumstances (Frankfort-Nachmias et al., 2015). Repeated measures do not typically impact external validity (Frankfort-Nachmias et al., 2015). The results of this study might not be generalizable due to the intended population and the limitation of the data collection. Data were analyzed from a regional facility which represent an unknown percentage of individuals with secondary hypogonadism who made the decision to visit a health clinic. Other individuals exist with secondary hypogonadism that are unaware the condition, or may be aware of the condition but may seek treatment from other facilities and professionals including religious leaders or naturopathic physicians.

It is also important to recognize that accessibility plays a role in determining which individuals made the decision to visit the health clinic utilized in this study. Physical, economic, and social dimensions are also factors that contributed to whether or not an individual made the decision to visit the health clinic used in the current study. A one-way rANOVA was used with this study to allow both dependent variables (depression and quality of life) to be measured with the same independent variable (time exposed to testosterone replacement therapy). I used a within-subject variable of interest (effect over time) to determine if the patients felt a difference from the first measurement (baseline) to the final measurement (2 months from baseline).

Internal Validity

Internal validity is the extent in which the effects of the study are due to the manipulation of the independent variable and not something else (Creswell, 2014; Frankfort-Nachmias et al., 2015). I used a one-way rANOVA to determine the impact that time exposed to testosterone replacement therapy has on depression and quality of life (Creswell, 2014; Frankfort-Nachmias et al., 2015). Threats to internal validity include the following biases which could be present in the population being studied: (a) self-report response bias, or the tendency for an participant to provide more positive or negative responses to questions; (b) selection–history bias, where participants being administered testosterone replacement therapy might differ from one another; (c) selection–maturation, where participants may have previous exposure to various types of testosterone replacement therapy methods compared to others who have not; (d) confounding variables, like the within-subjects designs test that measures the same

participants each time. Any number of circumstances or situations could have happened to any of the participants between measuring periods, like missing one or more doses (Creswell, 2014; Frankfort-Nachmias et al., 2015). Potential effects the subjects of this study reported include increases, decreases, or no noticeable changes to their quality of life or perceived levels of depression.

Ethical Procedures

Ethical behaviors and protection for all participating clients and information are a serious matter for those who conduct psychological studies. Every action in this study was taken with careful consideration in mind for the participants. Agreement to gain access to the data was received by way of a formal Data Use Agreement. The agreement was signed by both the data provider and the data recipient to allow the usage of the deidentified data set from the participating health clinic. The data were anonymous and the agreement was limited to the client's age, quality of life measurement, depression measurement, dates of the testosterone replacement therapy injections, and testosterone levels measured with a total-testosterone test.

This study did not involve any interactions with or observations of human participants. Permission to conduct this study was awarded from the Committee on Ethical Standards in Research from Walden University's Institutional Review Board (IRB) by completing an application to ensure that the ethical principles of beneficence and nonmaleficence, fidelity and responsibility, integrity, justice, and respect for people's rights and dignity were upheld during this study. The IRB granted final approval in February 2021; the approval number for this study is 02-19-21-0559221.

I used secondary data, limiting the ethical concerns related to recruitment materials, processes, and data collection. In the collection of the original data, it is hoped the initial collectors of the data were able to ensure that the participants were treated fairly. It is also assumed the original collectors ensured that limits of confidentiality were discussed and guaranteed during the initial data collection process.

The data were stored safely and securely during this entire process. In compliance with the State of Ohio guidelines, all data will be held for a minimum of seven years. The electronic copies of data that were received from the data provider are stored on a laptop with three levels of security and will require gained access entry.

I input the raw data into SPSS Version 27 for statistical analysis, using my personally secured, administrator password-protected laptop, equipped with antivirus, anti-spyware, and added Alexa protection. Following analysis, statistical data were then securely stored on a separate hard drive with restricted access by administrator password protection. Write permission was also disabled to ensure an additional security measure, preventing altercations of the data. The data will be kept for seven years as required by the state of Ohio and the American Psychological Association, which also fulfills Walden University's guidelines stating data must be kept for a minimum of five years. Copies are stored in two different locations. After seven years, the data will be securely disposed of and erased from the laptop. Secondary data allow for additional protections to both the population and myself.

Summary

In this chapter, I offered explanations and justifications behind the research methods employed in this study. A brief review and rationale of the study and reveals a repeated measures design is suitable due to the comparisons of the same subjects under different conditions. In this chapter I also described the target population, the health clinic setting, and the purposive sampling procedure. I discussed the utilization of secondary data analysis and presented the procedures involved for recruitment, participation and data collection. In this chapter, I covered details involving the instrumentation and operationalization of constructs specifically for the PHQ-9 and the QoLS. I also explored the data analysis plan through SPSS including the two RQs and the four hypotheses. In addition, I provided justification for threats to external and internal validity, including reliability of the instrument, data assumptions, sample size, and the measures taken to protect the rights of the participants. Finally, I provided a detailed description of the ethical procedures including the Data Use Agreement and concerns that came up with Walden University's IRB board. In Chapter 4, I offer detailed descriptions and justifications for the results.

Chapter 4: Results

Introduction

The purpose of this study was to investigate the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. I wanted to determine if a relationship existed between time exposed to testosterone replacement therapy and depression and quality of life among males under the age of 50 who had been diagnosed with secondary hypogonadism. In Chapters 1 and 2, I conveyed evidence of a gap in the literature while in Chapter 3, I provided an overview of the research method for the study. A rANOVA was used as the statistical tool for the dependent variables, which were depression and quality of life.

I begin this chapter by reviewing the RQs and hypotheses. Also discussed is the time frame for data collection, the response rates, basic demographic characteristics of the sample, statistical results, and a summary of the findings. I designed the study to explore the following RQs through evaluation of the corresponding hypotheses.

RQ1: Is the psychological aspect of quality of life significantly affected by testosterone replacement therapy maturation?

$H_0$1: The mean scores for the psychological aspect of quality of life, as assessed by the QoLS, do not differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

H_a1: The mean scores for the psychological aspect of quality of life, as assessed by the QoLS, do differ significantly over baseline, 1 month, and 2 months of

testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

RQ2: Is the psychological aspect of depression significantly affected by testosterone replacement therapy maturation?

$H_0$2: The mean scores for the psychological aspect of depression, as assessed by the PHQ-9, do not differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

H_a2: The mean scores for the psychological aspect of depression, as assessed by the PHQ-9, do differ significantly over baseline, 1 month, and 2 months of testosterone replacement therapy maturation, in males under the age of 50 suffering from secondary hypogonadism.

Data Collection

Walden University's Institutional Review Board (IRB) awarded approval (no. 02-19-21-0559221) in February 2021 to collect and analyze secondary data provided by a health clinic on the East Coast of the United States. The time frame for data collection was Spring 2021. The health clinic I partnered with sent, via email, pertinent information to me for 18 de-identified individuals, whose demographics met the required qualifying criteria (male, under the age of 50, receiving testosterone replacement therapy for secondary hypogonadism). I uploaded the de-identified information into SPSS Version 27 for data analysis. Of the 18 cases, 17 included all necessary points of data (baseline, 4-weeks, and 8-weeks) to be analyzed during the study. One of the individuals was missing

data for the Week-4 input, meaning that utilizing that particular individual's incomplete data was not acceptable. See Table 1 for a summary of the cases included and excluded from analysis.

Table 1

Case Processing Summary for Dependent Variables

	Cases					
	Valid		Missing		Total	
Dependent variable	N	%	N	%	N	%
Depression	17	94.4	1	5.6	18	100.0
Quality of life	17	94.4	1	5.6	18	100.0

The purposive sample ($N = 17$) was comprised of males under the age of 50, receiving testosterone replacement therapy for secondary hypogonadism. I used purposive sampling for this study because this particular health clinic collects specific information relevant to my study (specific to out-patient individuals using testosterone replacement therapy), while measuring various symptomatic descriptors. The primary objective of a purposive sample is to create a sample that is reasonably presumed to be representative of the population (Etikan et al., 2016). Purposive sampling means that the subset creates a sample that can be considered logically accurate, reflecting and aligning with the characteristics of the population for the purposes of analysis (Etikan et al., 2016).

Because I was interested in analyzing males under the age of 50 with low levels of testosterone, I made sure that the sample reflected those particular qualities (see Etikan

et al., 2016). The two dependent variables (depression and quality of life) were analyzed and measured in relation to the independent variable. The independent variable (time exposed to testosterone replacement therapy) consisted of three points in time, which included baseline (before the testosterone replacement therapy began), 1 month into treatment, and 2 months into treatment.

Results

Measures of Depression

I conducted a one-way rANOVA to determine whether there were statistically significant differences in levels of depression over the course of a 2-month exposure to testosterone replacement therapy. Table 2 shows the descriptive statistics for the dependent variable, depression. There were no outliers and the data were normally distributed, as assessed by a boxplot and a Shapiro-Wilk test ($p > .05$). The assumption of sphericity was not violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 4.32$, $p = .115$.

Some statisticians consider Mauchly's test a substandard procedure to expose violations of sphericity with it often failing to detect deviations from sphericity in smaller sample sizes (Kesselman et al., 1980; Maxwell & Delaney, 2004; Weinfurt, 2000). Maxwell and Delaney (2004) recommended that the unadjusted test should be avoided due to the extreme sensitivity of the one-way rANOVA to departures from sphericity. Instead, they recommended disregarding the result of Mauchly's sphericity test and utilizing the result of the Greenhouse-Geisser correction (Maxwell & Delaney, 2004). Therefore, a Greenhouse-Geisser correction was implemented ($\varepsilon = 0.800$). The

testosterone replacement therapy elicited statistically significant changes in levels of depression over an 8-week period of time, $F(1.60, 25.60) = 86.55$, $p < .001$, partial $\eta^2 = .84$, partial $\omega^2 = .76$, with levels of depression decreasing from baseline (M = 7.18, SD = 1.55) to 4 weeks (M = 4.94, SD = 1.03) to 8 weeks (M = 1.94, SD = 1.14).

Table 2

Descriptive Statistics for Depression

	Mean	Std. Deviation	*N*
Baseline	7.18	1.55	17
4 Weeks	4.94	1.03	17
8 Weeks	1.94	1.14	17

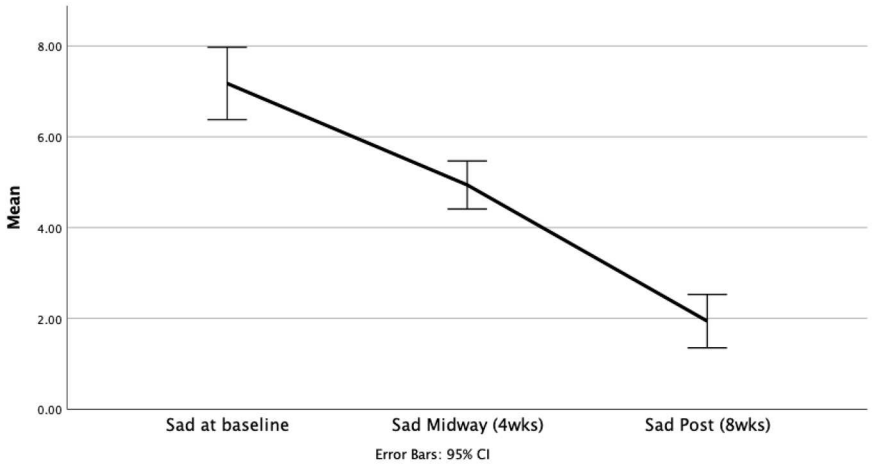
Post hoc analysis with a Bonferroni adjustment revealed that levels of depression statistically and significantly decreased from baseline to 4 weeks (M = 2.24, 95% CI [1.30, 3.17], $p = .001$) and from 4 weeks to 8 weeks (M = 3.00, 95% CI [2.08, 3.92], $p = .001$). Figure 5 shows the mean score of depression, spanning from baseline to Week 8. A statistically significant difference was noted between the means. Statistical significance is the probability that a relationship between variables is not due to random chance (Wagner & Gillespie, 2018).

The significance level (the alpha) was set to 0.05%. I used a one-tailed test because the relationship between variables was being analyzed in one direction (Wagner & Gillespie, 2018). The significance level was then compared to the *p*-value (Wagner & Gillespie, 2018). Statistical significance is present when the *p*-value is less than 0.05

(Wagner & Gillespie, 2018). Therefore, the null hypothesis was rejected, and the alternative hypothesis was accepted.

Figure 5

Mean of Depression Measured at Three Points in Time



Measures of Quality of Life

I conducted a one-way rANOVA to determine whether there were statistically significant differences in levels of quality of life over the course of an 8-week exposure to testosterone replacement therapy. Table 3 shows the descriptive statistics for the dependent variable, quality of life. There were no outliers, and the data were normally distributed, as assessed by a boxplot and a Shapiro-Wilk test ($p > .05$). The assumption of sphericity was not violated, as assessed by Mauchly's test of sphericity, $\chi^2(2) = 2.44$, $p = .296$. As mentioned previously in the results section, some statisticians consider Mauchly's test a substandard procedure to expose violations of sphericity with it often failing to detect deviations from sphericity in smaller sample sizes (Kesselman et al.,

1980; Maxwell & Delaney, 2004; Weinfurt, 2000). Maxwell and Delaney (2004) recommended that the unadjusted test be avoided due to the extreme sensitivity of the one-way rANOVA to departures from sphericity. Instead, they recommended disregarding the result of Mauchly's sphericity test and utilizing the result of the Greenhouse-Geisser correction (Maxwell & Delaney, 2004). Therefore, a Greenhouse-Geisser correction was applied ($\varepsilon = 0.870$).

The testosterone replacement therapy elicited statistically significant changes in levels of quality of life over an 8-week period of time, $F(1.74, 27.83) = 72.39$, $p < .001$, partial $\eta^2 = .82$, partial $\omega^2 = .74$, with quality of life levels increasing from baseline (M = 70.29, SD = 7.73) to 4 weeks (M = 79.12, SD = 6.52) to 8 weeks (M = 96.65, SD = 5.67).

Table 3

Descriptive Statistics for Quality of Life

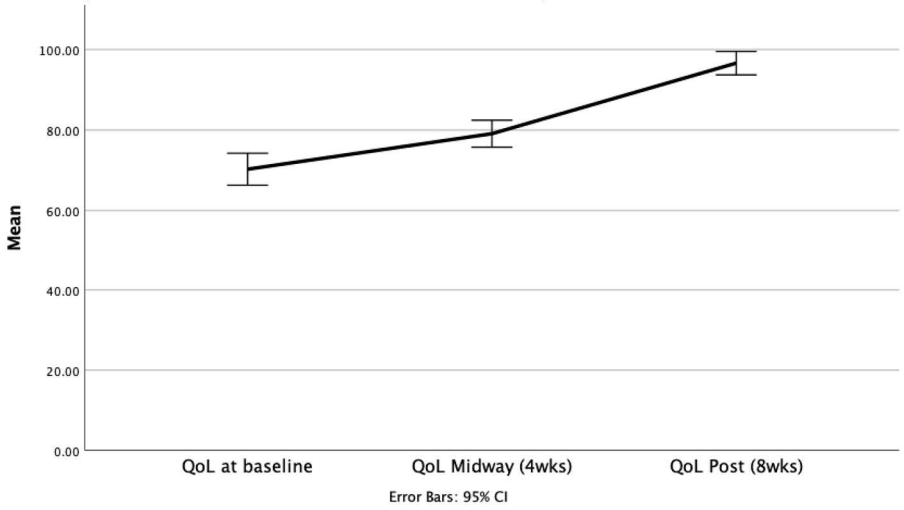
	Mean	Std. Deviation	*N*
Baseline	70.29	7.73	17
4 Weeks	79.18	6.52	17
8 Weeks	96.65	5.67	17

Post hoc analysis with a Bonferroni adjustment revealed that quality of life levels statistically and significantly increased from baseline to 4 weeks (M = 8.82, 95% CI [2.93, 14.72], $p = .003$) and from 4 weeks to 8 weeks (M = 17.53, 95% CI [12.63, 22.43], $p = .001$). Figure 6 shows the mean score of quality of life, spanning from baseline to

Week 8. A statistically significant difference was noted between means. Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted.

Figure 6

Mean of Quality of Life Measured at Three Points in Time



Evaluation of Repeated Measures ANOVA Assumptions

I conducted a one-way rANOVA to determine if there were significant differences in the levels of depression and quality of life over the course of 0, 4, and 8 weeks. The first step was to determine if the data had outliers and check to see if the data were normally distributed (Girden, 1991). There were no outliers in the data as assessed by inspection of a boxplot. I made use of the Shapiro-Wilk test of normality due to the sample size being considered small, or under 50 participants (see Girden, 1991). It is acceptable to run a single normality test for an analysis and to solely rely on that particular result (Girden, 1991; Wagner & Gillespie, 2018). Looking under the significance column of the Shapiro-Wilk test it was noted that all numbers were more

than .05 ($p > .05$), which indicated that the data were normally distributed. Both depression and quality of life levels were normally distributed at each point of time (baseline, 4 weeks, and 8 weeks), as assessed by Shapiro-Wilk's test ($p > .05$).

The second step was to carry out the one-way rANOVA with a post hoc test (Girden, 1991). This route was appropriate to investigate all possible pairwise comparisons, which are displayed in Tables 4 and 5. While a variety of post hoc tests exist, the one most suitable for assessing all pairwise comparisons in a one-way rANOVA involves running multiple paired-samples t-tests along with a Bonferroni adjustment for multiple comparisons (Girden, 1991).

Table 4

Pairwise Comparisons for Dependent Variable: Depression

		Mean Difference	95% Confidence Interval for Difference	
Length of time (A)	Length of time (B)	(A-B)	Lower Bound	Upper Bound
Baseline	4 Weeks	2.24	1.30	3.17
4 Weeks	8 Weeks	3.00	2.08	3.92
Baseline	8 Weeks	5.24	3.93	6.54

Table 5

Pairwise Comparisons for Dependent Variable: Quality of Life

		Mean Difference	95% Confidence Interval for Difference	
Length of time (A)	Length of time (B)	(A-B)	Lower Bound	Upper Bound
Baseline	4 Weeks	8.82	2.93	14.72
4 Weeks	8 Weeks	17.53	12.63	22.43
Baseline	8 Weeks	26.35	19.44	33.27

The third step was to interpret and determine whether the assumption of sphericity was violated (see Girden, 1991; Kesselman et al., 1980; Maxwell & Delaney, 2004; Weinfurt, 2000). Mauchly's test of sphericity was not statistically significant ($p > .05$), indicating that the assumption of sphericity was met, and not violated for both dependent variables: depression and quality of life (Girden, 1991; Kesselman et al., 1980; Maxwell & Delaney, 2004; Weinfurt, 2000). As suggested by some statisticians (Girden, 1991; Kesselman et al., 1980; Maxwell & Delaney, 2004; Weinfurt, 2000), I ignored Mauchly's test and assumed that sphericity was in all likelihood violated.

The fourth step was to analyze and report the effect size (Girden, 1991). Several different measures of effect size exist for a one-way rANOVA and there does not seem to be a universal or global preference (Girden, 1991; Wagner & Gillespie, 2018; Weinfurt, 2000). Typically speaking, the estimate of the population effect size is preferred to the sample effect size (Stevens, 2007). The estimate of the population effect size (partial ω^2), is the estimated value of partial η^2 in the population (Girden, 1991; Stevens, 2007). SPSS does not report partial ω^2 but it can be calculated using a formula provided to statisticians labeled in Figure 7 (Keppel and Wickens, 2004). The value of partial ω^2 is lower than the partial η^2 because the partial ω^2 compensates for bias (Keppel and Wickens, 2004).

Figure 7

Formula for Calculating the Population Effect Size

$$\omega^2 = \frac{(k-1)(F-1)}{(k-1)(F-1)+nk}$$

k = number of levels of the within-subjects factor
F = value of the F statistic
n = number of participants

The fifth step was to interpret and report the post hoc tests with a Bonferroni adjustment (Girden, 1991; Stevens, 2007). After determining the one-way rANOVA was statistically significant ($p < .05$) for both variables, post hoc tests were utilized to determine where the differences between levels of the within-subjects factor lie (Girden, 1991). There was a decrease in levels of depression from baseline (M = 7.18, SD = 1.55) to 8 weeks into the testosterone treatment (M = 1.94, SD = 1.14), a statistically significant mean decrease of -5.24, 95% CI [3.93, 6.54], $p < .001$ (see Table 4). There was an increase in levels of quality of life from baseline (M = 70.29, SD = 7.73) to 8 weeks into the testosterone treatment (M = 96.65, SD = 5.67), a statistically significant mean increase of 26.35, 95% CI [19.44, 33.27], $p < .001$ (see Table 5). There were statistically significant differences between the means for both variables (depression and quality of life). The end result was rejecting the null hypotheses and accepting the alternative hypotheses.

Summary

The RQs addressed in this study were (a) Is the psychological aspect of quality of life significantly affected by testosterone replacement therapy maturation and (b) Is the psychological aspect of depression significantly affected by testosterone replacement therapy maturation? The results of this research study indicate there were statistically significant differences in the levels of depression and quality of life for males under the age of 50 suffering from secondary hypogonadism. Overall, the men who participated in the testosterone replacement therapy reported feeling decreased levels of depression and increased levels of quality of life as the duration of the testosterone replacement therapy lengthened. In Chapter 5, I provide an interpretation of my findings, examine the limitations, make recommendations, analyze the implications and conclude with thoughts of my study in its entirety.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative study was to investigate the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. While conducting the literature review for this study, I discovered a lack of previous research on this specific topic. Although researchers have found that depression and poor quality of life are associated with testosterone replacement therapy among older men with secondary hypogonadism (see Busnelli et al., 2017; Cohen et al., 2020; Dudek et al., 2017; Hackett, 2016; Huo et al., 2016; Mascarenhas et al., 2016; Nian et al., 2017), they have overlooked the psychological effects for younger males. In the minimal amount of research that exists on the younger male population with secondary hypogonadism, the primary focus has been on the sexual and somatic effects of the testosterone replacement therapy (e.g. Hackett, 2016; Huo et al., 2016; Hwang & Miner, 2015; Morales et al., 2015; Yassin et al., 2016). Academics within the field of clinical psychology have done minimal to no research, according to my review of the literature, on the psychological effects of testosterone replacement therapy for younger males with secondary hypogonadism. I conducted this study to address this gap in the literature.

The study featured a quantitative, non-experimental design that involved analysis of secondary data to assess the psychological aspects of a male's life including symptoms of depression and the quality of life (Akturk & Nippolt, 2016; Aydogan et al., 2012; Huo et al., 2016; Hwang & Miner, 2015; Javed et al., 2015; Lasaite et al., 2016; Morales et al., 2015; Shiraishi et al., 2014; Uddin et al., 2017). I used the PHQ-9 (Chen et al., 2016;

Manea et al., 2015; Mitchell et al., 2016) to operationalize, diagnose, monitor, and measure perceived levels of depression in patients. I also utilized the QoLS (Burckhardt & Anderson, 2003) to operationalize and measure quality of life in patients.

I analyzed the independent variable (time exposed to testosterone replacement therapy measured at baseline, 1 month, and 2 months) was analyzed alongside the two dependent variables (quality of life and depression). Two separate one-way rANOVAS were conducted to determine whether there were statistically significant differences in the levels of depression and quality of life over the course of an 8-week exposure to testosterone replacement therapy. This study found that as time progressed, men under the age of 50 with secondary hypogonadism who partook in ongoing testosterone replacement therapy generally reported decreased levels of depression and increased levels of quality of life.

Interpretation of the Findings

This study contributes to the research and literature by offering further evidence of the efficacy of testosterone replacement therapy for males under the age of 50 who suffer from various negative psychological symptoms. Previous research suggested the benefit of using testosterone replacement therapy for the aging male population and indicated the need for studies to further the investigation with the younger male populations (Hackett, 2016; Huo et al., 2016; Izzo, 2016; Konaka et al., 2016; Lee & Tillman, 2016). I addressed this gap in the literature by examining the psychological benefits of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism (Hackett, 2016; Huo et al., 2016; Izzo, 2016; Konaka et al., 2016; Lee &

Tillman, 2016). I did so by analyzing secondary data for males receiving testosterone replacement therapy.

As mentioned in Chapter 2, previous researchers differed in their views concerning the efficacy of testosterone replacement therapy (Shiraishi et al., 2014; Uddin et al., 2017). The scholarly research currently available tends to focus on the relationship of testosterone levels for males over 50 years of age (Aydogan et al., 2012; Huo et al., 2016; Lasaite et al., 2016). Some of the literature mentions males under the age of 50 in relation to testosterone replacement therapy but focuses more on the sexual and somatic issues (Aydogan et al., 2012; Dhindsa et al., 2018; Hackett, 2016; Huo et al., 2016; Hwang & Miner, 2015; Morales et al., 2015; Yassin et al., 2016). The literature review yielded mixed findings, which suggested variations in study design and demographics (Akturk & Nippolt, 2016; Aydogan et al., 2012; Huo et al., 2016; Hwang & Miner, 2015; Javed et al., 2015; Lasaite et al., 2016; Morales et al., 2015; Shiraishi et al., 2014; Uddin et al., 2017). This study focused on the relationship between the independent variable (time exposed to testosterone replacement therapy) and the dependent variables (depression and quality of life).

The findings of this study are consistent with those of researchers who reported that testosterone replacement therapy may psychologically benefit males of any age (Aydogan et al., 2012; Huo et al., 2016; Lasaite et al., 2016; Morgentaler et al., 2016). Data provided for this study suggest that males under the age of 50 with secondary hypogonadism tend to see significant decreases in levels of depression and significant increases in quality of life levels. These findings build upon previous studies by showing

that psychological benefits of testosterone replacement therapy are effective for males under the age of 50. This study addressed the gap in the literature and helps provide clarification, options, and avenues for social change by supplying new information on a viable treatment method. This study is important in practice because it substantiates the benefits of utilizing testosterone replacement therapy to provide solace to males under the age of 50 with secondary hypogonadism. This benefit continues beyond the individuals being treated with testosterone replacement therapy, and extends into the fields of medicine and psychology where it provides knowledge of a medical issue that mimics various negative psychological symptoms.

Limitations of the Study

External Validity

External validity, also known as generalizability, is the extent to which the results of this study are generalizable to other individuals and circumstances (Frankfort-Nachmias et al., 2015; Lesko et al., 2017). Repeated measures, such as the one used in my study, do not typically impact external validity (Dannels, 2018; Frankfort-Nachmias et al., 2015). The results of this study are difficult to generalize due to the intended population and the limitation of the data collection. I analyzed data from a regional facility which represented an unknown percentage of individuals with secondary hypogonadism who made the decision to visit a health clinic. The deidentified secondary data I received did not offer any information relating to race, ethnicity, or previous medical/mental health conditions. The identifying factors were limited to age, gender, type of hypogonadism, and testosterone levels.

I did not have access to all populations of interest. The representative sample was small and may not accurately represent males under the age of 50 with secondary hypogonadism on a global level. The accessible population was the portion of the population to which I had access via secondary data gathered from one particular region in the United States. The sample gathered was a reflection of the population served by the study clinic; it is not reflective of other regions of the United States or other countries in the world.

Frankfort-Nachmias et al. (2015) pointed out that using secondary data is also considered a limitation. With secondary data, an inability exists in controlling how the data are gathered, generated, and recorded (Frankfort-Nachmias et al., 2015). Relying on other individuals to gather information accurately is an unknown, which may be a limitation to this study's validity (Frankfort-Nachmias et al., 2015).

Internal Validity

Internal validity is the extent to which the effects of a study are due to the manipulation of the independent variable and not something else (Creswell, 2014; Frankfort-Nachmias et al., 2015). Repeated measures designs tend to have a strong statistical power (Creswell, 2014; Frankfort-Nachmias et al., 2015). This strength is due to an increased number of data points being gathered from the same number of participants (Creswell, 2014; Frankfort-Nachmias et al., 2015). Within-subjects designs tend to have more statistical power than when compared to a between-subjects design (Creswell, 2014; Frankfort-Nachmias et al., 2015).

The duration that the participants were exposed to testosterone replacement therapy is a possible limitation of this study. Psychological researchers tends to measure in increments of 6 months to 1 year, with medical measurements typically occurring at 3 months, 6 months, and biannually after that (Cherrier et al., 2015; Corona et al., 2016; Izzo et al., 2016; McCullough, 2015). This limitation is important to note because 4 to 8 weeks on testosterone replacement therapy may suggest a correlation, but it does not automatically equate to causation.

I used an experimental group so a variety of potential threats arose for internal validity (Creswell, 2014; Frankfort-Nachmias et al., 2015). Maturation effects were analyzed but deemed not applicable. A maturation effect happens when alterations in a score over the course of time are attributed to naturally-occurring internal processes (Blalock, 2018; Dannels, 2018). Males diagnosed with secondary hypogonadism have to either supplement their testosterone because their body is faulty and not producing adequate amounts, or go without.

I analyzed history effects. These may be a possible threat because they take into account external events that may have occurred between the measurements. For example, this study took place in the spring, and as the weather got nicer, perhaps some or all of the participants started spending more time outside, which in turn may have been partially responsible for improving moods.

I also analyzed testing effects and deemed it a possible threat. Perhaps the questions asked at baseline (before the testosterone replacement therapy started) primed

the participants in some way. It is possible that the baseline measurement affected how the participants answered the follow-up questionnaires in weeks 4, and weeks 8.

I analyzed instrument decay but deemed it not applicable because the decay happens when the standards of a measuring device change over the course of time. The assessments used to measure depression and quality of life have not changed in years, and the exact same assessments were utilized during baseline, week 4, and week 8 (Burckhardt & Anderson, 2003; Chen et al, 2016; Manea et al., 2015; Mitchell, et al., 2016). Furthermore, the exact same measurements were utilized during baseline, Week 4, and Week 8.

I analyzed statistical regression toward the mean but it was deemed not applicable. Statistical regression would convey that the participants were chosen based on extreme scores, which they were not. Although it is true the participants all had confirmed low levels of testosterone before partaking in the study, it was not confirmed whether or not the participants had decreased levels of quality of life and depression.

I analyzed self-report response bias and deemed it a conceivable threat, as it was possible the participants provided inaccurate or false responses to questions. It is possible that a placebo effect took place. The participants came in expecting testosterone replacement therapy and were given the questionnaires relating to depression and quality of life before they were given the first treatment dosage. It is possible that the participants felt pressure or some type of demand during Weeks 4 and 8 to demonstrate through the questionnaires increased levels of quality of life and decreased levels of depression.

I analyzed demand characteristics and deemed them a possible threat because sometimes participants expect they are being evaluated, which can result in them trying to attain particular scores (Allen, 2017). Demand characteristics cannot be completely eliminated, although decreasing their impact on research results is possible (Allen, 2017). Due to the data collection method being secondary, reducing or controlling for the potential impact of demand characteristics was not possible.

Recommendations

To strengthen the reliability and generalizability, future researchers and academics could take into account and evaluate possible variances based on location, age, and timeframe. Future researchers could also run an experimental design and have a control group. In addition, they could analyze and take into account the relationships between the participants' ethnicity, current medical conditions, mental diagnoses, and other markers that may affect results. Future researchers could also run a longitudinal study and set the measuring points 1, 2, 5, or 10 years apart from one another. Future researchers could even analyze various methods to administer testosterone and see if there is a correlation or relationship between the methods and the outcomes.

This study was not able to provide conclusive evidence for explanations of causation. It does appear though, that a correlation exists between time exposed to testosterone replacement therapy and improved perceptions of quality of life and decreased levels of depression. This study is at the beginning of research exploration for psychologists looking to learn and discover more about the psychological benefits of

testosterone replacement therapy for men under the age of 50 with secondary hypogonadism.

Additionally, research psychologists could explore the qualitative impact of how testosterone replacement therapy affects the family members of men under the age of 50 diagnosed with secondary hypogonadism. The newness of this study requires continuing research to assist in uncovering useful information to an underserved population. With respect to furthering the understanding of the benefits of testosterone replacement therapy for men under the age of 50 with secondary hypogonadism, recommendations can be made for future research based on the limitations discussed earlier in Chapter 5. This study is then able to be used to guide future research which can allow for more detailed assertions of testosterone replacement therapy as a beneficial treatment for males with secondary hypogonadism.

First, I recommend that this study be conducted again with the involvement of more medical clinics and participants so that the sample size will be larger and more robust. Second, I recommend that this study be conducted again taking into account longer periods of measurement than what the current secondary data provided. Measuring at 6 months, 1 year, 2 years, 5 years, and 10 years may provide additional insight regarding participants' levels of quality of life and depression. More specific data may also allow researchers to analyze various influencing factors including but not limited to: pituitary disorders, inflammatory disease, medications, obesity, and malnutrition. Additional dependent variables could be analyzed as well including but not limited to: anxiety, aggression, and stress.

Implications for Positive Social Change

The intention of this study was to investigate the psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism. Synthetic testosterone was created to help mitigate the negative effects for those individuals with naturally low testosterone (Nieschlag, & Nieschlag, 2019). As the most essential male hormone, testosterone has an impact on almost all human organs (Nieschlag, & Nieschlag, 2019). The results of this study address the misconception that low testosterone exclusively correlates with age and provides a deeper understanding of the positive psychological effects of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism (Aydogan et al., 2012; Basaria, 2014; McCullough, 2015). The potential implications for positive social change includes contributing to and furthering scientific knowledge and awareness in the field of psychology, by way of investigating the psychological effects of testosterone replacement therapy for males under the age of 50 diagnosed with secondary hypogonadism.

The results of this study brings awareness to an existing population of younger males who acquire hypogonadism due to malfunctions of the pituitary gland or hypothalamus (Dudek et al., 2017; Forni & Wray, 2015; Lee & Tillman, 2016). The more knowledge is available to males, the better informed they will be when making a decision whether or not to partake in testosterone replacement therapy. The findings of this research also bring awareness to scholars and professionals in fields of both medicine and psychology of a medical issue that mimics psychological symptoms including depression, anxiety, and various other *DSM-5* diagnoses (Issacs & Thomas, 2015; Kim et al., 2016;

Lee & Tillman, 2016; Samahy et al., 2021; Veras & Nardi, 2010). The findings of this research also bring awareness to neuropsychologists, neurologists, endocrinologists, and internal medicine specialists of a medical issue that can result from traumatic brain injury or mimic its symptoms (Issacs & Thomas, 2015; Sterling et al., 2015; Tanriverdi et al., 2015). It is important for psychologists and neuropsychologists to keep in mind the relevance of a patient's medical history before considering a diagnosis (Issacs & Thomas, 2015; Lee & Tillman, 2016). Education and awareness of low testosterone issues allows for increased accuracy of diagnoses (Issacs & Thomas, 2015; Lee & Tillman, 2016).

Implications of this study start small and will continue to grow larger. The health clinic that provided the secondary data for this study requested results so they could provide scientific backing of their work to potential clients. The health clinic that provided the secondary data also expressed future interest in co-researching and co-authoring several additional longitudinal studies, each looking at various psychological benefits of testosterone therapy for males with secondary hypogonadism. A psychology convention taking place in France in Spring of 2023 also expressed an interest in having the findings of this study shared. It is my intention that increasing the numbers of providers and clinicians within the psychological community who are educated on hypogonadism, will create a deeper understanding of the importance of collaborative care and furthering education. The results of this study promote continuing psychological and medical breakthroughs and support for this underserved population (Issacs & Thomas, 2015; Lee & Tillman, 2016). This study has the potential to impact both fields of medicine and psychology.

Conclusion

Men under the age of 50 who present to their medical providers with symptoms of depression should be offered a blood test as part of the lab work to rule out whether or not secondary hypogonadism is a possible contributing factor. Men under the age of 50 who present to their mental health providers with symptoms of depression should be pointed in the direction of their general practitioner and given a recommendation to have their blood tested for testosterone levels to rule out whether or not secondary hypogonadism is a possible contributing factor.

This study contributes to the literature gap, looking at the psychological benefits of testosterone replacement therapy for males under the age of 50 with secondary hypogonadism while providing ideas and areas for future research (Hackett, 2016; Huo et al., 2016; Izzo, 2016; Konaka et al., 2016; Lee & Tillman, 2016). The results between each period of time (baseline, 4 weeks in, and 8 weeks in) suggest increases in the reported quality of life levels as well as decreases in the reported levels of depression. These findings are not only relevant to those individuals who are diagnosed with secondary hypogonadism, but to the medical, neurological, and psychological providers in general.

The findings of this study remind medical, neurological, and psychological professionals to be mindful of patient issues that span multiple realms as explained with the biopsychosocial model (Engel, 1977; Jorn, 2015; Vongas & Alhaji, 2015; Wade & Halligan, 2017). This study has demonstrated with statistical and clinical significance, that men under the age of 50 who have been diagnosed with secondary hypogonadism,

and who are being treated with testosterone replacement therapy, experience increased levels of quality of life and decreased levels of depression.

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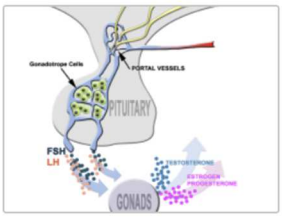
Appendix A: Figure Permissions

Minerva Spurlock
Wed 2/20/2019 2:50 PM
pforni@albany.edu



Dr. Forni,

My name is Minerva Spurlock, I am working on my dissertation in clinical psychology. My topic is looking at the psychological benefits of testosterone replacement therapy for males with hypogonadotropic hypogonadism. I am referencing your 2015 article, "GnRH, anosmia and hypogonadotropic hypogonadism – Where are we?"
I was hoping to obtain your permission to use Figure 1 from that article. I am attaching it to this email so you know exactly which picture I would like to reference. Thank you so much for the consideration, your work is fantastic. ^_^

Minerva Spurlock QMHP, MS
Ph.D. Clinical Psychology Internship Student

Forni, Paolo E <pforni@albany.edu>
Wed 2/20/2019 2:53 PM
Minerva Spurlock

Please use it, no problem!
Thank for asking.
P

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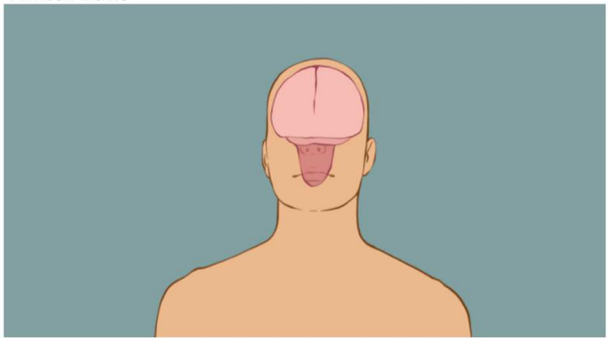
From: **Kimball Davis** <*kimballgraydavis@...*> 7:49 AM (an hour ago)

To: mspurlock@protonmail.com

Show details

Here are the two art pieces for you as requested. Have a great day!
-Kimball Davis



Appendix B: Key Words Used to Locate Literature for the Study

The following is an exhaustive list of key words, terms, and phrases used during the current research project: *testosterone*, *free testosterone*, *bioavailable testosterone*, *low testosterone*, *testosterone restoration*, *gonadotropin*, *hypopituitarism*, *hypogonadism*, *hypogonadal*, *hypogonadotropic hypogonadism*, *primary hypogonadism*, *secondary hypogonadism*, *central hypogonadism*, *late-onset hypogonadism*, *testosterone replacement*, *testosterone replacement therapy*, *testosterone therapy*, *testosterone levels*, *testosterone deficiency*, *testosterone effects*, *low testosterone*, *low testosterone levels*, *pituitary dysfunction*, *pituitary gland disfunction*, *pituitary hormone dysfunction*, *pituitary-gonadal dysfunction*, *hypothalamus disfunction*, *hypothalamic dysfunction*, *hormones*, *androgens*, *brain injury*, *traumatic brain injury*, *men*, *males*, *age*, *young*, *younger*, *middle-aged*, *older*, *elderly*, *endocrinology*, *neuroendocrine*, *neuroendocrinology*, *internal medicine*, *depression*, *quality of life*, *Patient Health Questionnaire*, *Quality of Life Scale*, *biopsychosocial*, *psychological*, *impact of*, *benefits of*, *effect of*, *risks*, *implications*, *reliability*, *validity*, *utilization*, *treatment*, *literature review*, *peer-reviewed*, *seminal*, *review articles*, *systematic reviews*, *empirical studies*, and *meta-analysis.*

Appendix C: Instrumentation Used for Operationalization of Constructs

I included two instruments, the PHQ-9 and the QoLS. Kroenke et al. (2001) developed the PHQ-9 with funding from Pfizer. Permission to use the instrument is not necessary because it is in the public domain.

The Patient Health Questionnaire (PHQ-9)

Patient Name _____ Date of Visit _____

Over the past 2 weeks, how often have you been bothered by any of the following problems?	Not At all	Several Days	More Than Half the Days	Nearly Every Day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed or hopeless	0	1	2	3
3. Trouble falling asleep, staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself - or that you're a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or, the opposite - being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3
Column Totals	_____ +	_____ +	_____	
Add Totals Together	_____			

10. If you checked off any problems, how difficult have those problems made it for you to Do your work, take care of things at home, or get along with other people?

☐ Not difficult at all ☐ Somewhat difficult ☐ Very difficult ☐ Extremely difficult

Flanagan developed the QoLS in the 1970s (Burckhardt & Anderson, 2003; Gupta & Venkatesan, 2018). Permission to use this instrument is not necessary because it is in the public domain.

QUALITY OF LIFE SCALE (QOL)

Please read each item and circle the number that best describes how satisfied you are at this time. Please answer each item even if you do not currently participate in an activity or have a relationship. You can be satisfied or dissatisfied with not doing the activity or having the relationship.

	Delighted	Pleased	Mostly Satisfied	Mixed	Mostly Dissatisfied	Unhappy	Terrible
1. Material comforts home, food, conveniences, financial security	7	6	5	4	3	2	1
2. Health - being physically fit and vigorous	7	6	5	4	3	2	1
3. Relationships with parents, siblings & other relatives- communicating, visiting, helping	7	6	5	4	3	2	1
4. Having and rearing children	7	6	5	4	3	2	1
5. Close relationships with spouse or significant other	7	6	5	4	3	2	1
6. Close friends	7	6	5	4	3	2	1
7. Helping and encouraging others, volunteering, giving advice	7	6	5	4	3	2	1
8. Participating in organizations and public affairs	7	6	5	4	3	2	1
9. Learning- attending school, improving understanding, getting additional knowledge	7	6	5	4	3	2	1
10. Understanding yourself - knowing your assets and limitations - knowing what life is about	7	6	5	4	3	2	1
11. Work - job or in home	7	6	5	4	3	2	1
12. Expressing yourself creatively	7	6	5	4	3	2	1
13. Socializing - meeting other people, doing things, parties, etc	7	6	5	4	3	2	1
14. Reading, listening to music, or observing entertainment	7	6	5	4	3	2	1
15. Participating in active recreation	7	6	5	4	3	2	1
16. Independence, doing for yourself	7	6	5	4	3	2	1