Fear of Death, Dissection Avoidance Behaviors, and Performance in Gross Anatomy Courses with Cadaveric Dissection

by

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There is debate as to whether or not cadaveric dissection is the best way to introduce future healthcare providers to death and dying issues. While some anatomists feel that dissection is essential and provides an important launching point for students' development of ideas and attitudes about death and dying, others argue that it may not be an appropriate way to introduce students to these sensitive issues. Literature has established cadaveric dissection as a source of anxiety for anatomy students. It has also been associated with negative reactions such as nausea, fear, insomnia, recurring images, nightmares, and loss of appetite. However, it remains largely unknown how this personal encounter with death impacts students' fear of death.

The current study aimed to address this gap by describing how medical and dental students' fear of death changes with continued exposure to cadaveric dissection. Furthermore, we aimed to describe the relationship between students' fear of death, cadaveric dissection avoidance behaviors, and their gross anatomy performance. Students were first surveyed at the beginning of their gross anatomy course, before they began dissection. This survey collected demographic data along with information regarding prior anatomy experiences. This survey also included three of the eight subscales from the Multidimensional Fear of Death Scale (MFODS); Fear of the Dead, Fear of Being Destroyed, and Fear for the Body After Death. These three subscales consisted of 16 items which were chosen based on their relevance to the dissection experience. Students were also surveyed at the conclusion of each exam block. These follow-up surveys collected data regarding students' avoidance of dissection and also included the three subscales from the MFODS. Written and practical examination scores were obtained from the anatomy course directors at the conclusion of the course.

Thirty-nine of 40 dental students (97.5%) and 143 of 165 medical students (86.7%) completed the initial survey. For medical students, repeated measures ANOVA

showed no significant changes in Fear of the Dead (F (4, 108) = 1.45, p = .222) or Fear for the Body After Death (F (4, 108) = 1.83, p = .129) throughout the semester. However, there was a significant increase in medical students' Fear of Being Destroyed (F (4, 108) = 6.86, p < .0005). Dental students had similar results, with no change in Fear of the Dead (F (3, 32) = .374, p = .772) or Fear for the Body After Death (F (3, 32) = 1.221, p = .318), but a significant increase in Fear of Being Destroyed (F (3, 32) = 4.683, p = .008). Increases in both groups were primarily related to students' decreased willingness to donate their body after their dissection experience. Instructors might consider modifying dissection laboratories to mitigate this negative shift in attitudes toward dissection.

Fear of death was associated with avoidance behaviors, particularly for the medical students, while the correlation between fear of death and performance was inconsistent. It appears that students with higher fear of death may use some avoidance behaviors to cope with dissection, but performance does not seem to be negatively impacted.

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LIST OF ABBREVIATIONS

DAT, Dental Admissions Test

GPA, Grade Point Average

MCAT, Medical College Admissions Test

MFODS, Multidimensional Fear of Death Scale

INTRODUCTION

Cadaveric dissection is sometimes described as the cornerstone of teaching gross anatomy (Mc Garvey, Hickey, & Conroy, 2015). Students often spend hours upon hours in the cadaver laboratory, uncovering and naming structures of the human body. While alternative methods have been introduced, some anatomists maintain that dissection is still superior. Dissection allows for the viewing of three-dimensional structures and relationships and a tactile experience of the tissue of the human body that would be impossible to gain any other way (Granger, 2004). It also provides students with an opportunity to explore anatomical variability (Ellis, 2001), work as part of a team (Granger, 2004) and visualize various pathologies within the human body (Parker, 2002).

However, some students seem to struggle with cadaveric dissection and experience negative reactions to this process. Literature has shown that students experience nausea, recurring images, dizziness (Snelling, Sahai, & Ellis, 2003), fear, insomnia (Russa & Mligiliche, 2014), nightmares, and loss of appetite associated with dissection (Singroha, Verma, Malik, Chhikara, & Yadav, 2017). General anxiety is one of the most often reported symptoms (Bernhardt, Rothkötter, & Kasten, 2012; Hancock, Williams, & Taylor, 1998; Hussein, Dany, Forbes, Thompson, & Jurjus, 2015; Penney, 1985; Plaisant et al., 2011; Quince, Barclay, Spear, Parker, & Wood, 2011; Russa & Mligiliche, 2014; Wisenden et al., 2018) with as many as 81% of students expressing some sort of anxiety surrounding dissection.

These symptoms, particularly anxiety, could be attributed to a multitude of factors. Students may be concerned about their ability to successfully complete the dissection, to achieve their desired grade in the course, or to work in harmony with other members of the dissection group. It remains mostly unknown how the direct confrontation with death and dying impacts the student, specifically how gross anatomy cadaveric dissection affects fear of death.

Fear of death and death anxiety have been defined as two separate terms with fear stemming from a clear threat and anxiety being linked to uncertainty (Nyatanga & de Vocht, 2006). However, these terms are often used interchangeably in much of the literature concerning these two concepts (Neimeyer & Moore, 1994). In the clinical setting, higher death anxiety has been associated with a more negative attitude about caring for dying patients (Peters et al., 2013). Also, nurses with higher death anxiety are less comfortable communicating with patients and families about issues surrounding death and dying (Deffner & Bell, 2005). Since death anxiety has been shown to impact

clinical care, it is important to understand this construct in future healthcare professionals, particularly when students are faced with death and dying issues, perhaps for the first time, in the gross anatomy laboratory.

Fear of death and death anxiety has been examined a number of times in healthcare students, especially in medical students. When compared to the general public, medical students actually reported lower fear of death (Thorson & Powell, 1991). Medical students have even reported lower fear of death compared to dental students (Sundin, Gaines, & Knapp, 1980). There is also evidence that over the course of health professional programs, fear of death and death anxiety remain relatively stable. Using the Collett-Lester Fear of Death scale, Theimann and colleagues (2015) found that medical student fear of death remained stable throughout their six year medical program. Using the same scale, Sundin and colleagues (1980) demonstrated this stability in fear of death throughout a four-year dental program. Only one study has analyzed changes in death anxiety throughout a gross anatomy course. Dickinson (1997) used the Death Anxiety Scale before medical students first dissection and after the conclusion of the course. They found that 54% of students' death anxiety decreased, 29% increased, and 18% showed no change. There may have been specific parts of the dissection process that had greater impact on death anxiety, but these could have been overlooked with only two points of data collection.

There have been no studies to date that have explored the relationship between fear of death and dissection avoidance. In dissection laboratories, there may be students who shy away from dissection. Some students may even hesitate to touch the cadaver or witness other students perform the dissection. Since these students are spending less time interacting directly with the cadaver, it is possible that these students' performance in the gross anatomy course could be negatively impacted. The current study has been designed to address these concepts and answer the following research question: In a gross anatomy course with cadaveric dissection, is there a relationship between fear of death, dissection avoidance behaviors, and performance throughout the semester? This question will be addressed using the following specific aims:

1. Describe how gross anatomy students' fear of death changes with continued exposure to cadaveric dissection.

2. Describe the relationship between students' fear of death, cadaveric dissection avoidance behaviors, and gross anatomy performance.

For the current study, students' fear of death will be assessed using the Multidimensional Fear of Death Scale (MFODS) developed by Hoelter (Hoelter, 1979). Hoelter defines fear of death as "an emotional reaction involving subjective feelings of unpleasantness and concern based on contemplation or anticipation of any of the several facets related to death" (Hoelter, 1979, p.996). The MFODS has been proven to have strong internal consistency, test-retest reliability, and construct validity (Neimeyer & Moore, 1994). Only three of the original eight subscales were used in the current study: Fear of the Dead, Fear of Being Destroyed, and Fear for the Body After Death. These three subscales were chosen as these items were most relevant to gross anatomy students' experience in the dissection laboratory.

Dissertation Overview

Chapter two contains a review of the literature related to dental and medical students' fear of death in a gross anatomy course with cadaveric dissection. This will begin with a brief summary of the history of cadaveric dissection and the many benefits it may offer, including that it provides an early introduction to death and dying issues. Negative reactions to dissection will then be discussed, followed by a summary of coping mechanisms utilized by students and interventions designed to help students manage the stressors of dissection. Next, fear of death will be defined and trends within the general population, medical students, and dental students will be described. Specific information concerning the MFODS will conclude this chapter.

Chapter three describes the methodology of the study. It begins with an overview of the institution and details concerning the structure of the medical and dental gross anatomy courses. The initial and follow-up surveys, which both include three subscales from the MFODS, are described. This chapter concludes with an outline of the data collection procedures and a plan for statistical analysis.

Chapter four contains results from the research study. Dental and medical student data are presented independently. For both cohorts demographics are presented first, followed by preliminary analyses. Next, results pertaining to changes in fear of death are presented for the entire group and by gender. Significant changes are further examined in the follow-up analyses. Lastly, results concerning the relationships between

fear of death, dissection avoidance behaviors, and examination performance are presented.

Chapter five is the discussion of the results. Dental and medical findings are discussed together, but are not directly compared. This section begins by addressing the first and second aim, including how findings from the study fit into the current literature and implications for anatomy faculty. Limitations are then discussed, followed by directions for future research.

Chapter six provides a final summary of the aims, results, and implications of the study.

REVIEW OF THE LITERATURE

Cadaveric Dissection

Cadaveric dissection has withstood the test of time and is considered by some to be the cornerstone of teaching anatomy to professional health science students (McGarvey, Hickey, & Conroy, 2015). The practice of cadaveric dissection began with Herophilus, often called the "father of anatomy", at a Greek school of medicine in Alexandria (Elizondo-Omaña, Guzmán-López, & De Los Angeles García-Rodríguez, 2005). After the passing of Herophilus, cadaveric dissection was mostly discontinued throughout the Middle Ages (Ghosh, 2015) as the church insisted that material things were of little importance. Therefore the study of the human body, and dissection in particular, was considered blasphemous (Gregory & Cole, 2002). During this period, the primary source of anatomical knowledge were texts written by Galen which were based on animal dissections (Dyer & Thorndike, 2000).

The beginning of the Renaissance period brought renewed vigor to the study of anatomy. Artists including Donatello, Michelangelo, Raphael and Leonardo da Vinci took part in cadaveric dissection in order to accurately illustrate the human form (Malomo, Idowu, & Osuagwu, 2006). They were soon followed by Vesalius who wrote the influential *De Humani Corporis Fabrica* (On the Fabric of the Human Body) which was based on cadaveric dissections that he performed (Malomo et al., 2006). In contrast to anatomical studies of the previous centuries, Vesalius insisted that dissection of the human body should be conducted using scientific reasoning and discovered through direct observations (Dyer & Thorndike, 2000). In the following years, cadaveric dissections were performed frequently. In order to keep up with the demand for bodies, the unethical practice of grave-robbing began and the concerned public started to question the necessity and morality of cadaveric dissection (Ghosh, 2015). However, with the passing of legislation such as the Uniform Anatomical Gift Act (1968) and changing social beliefs, cadaveric dissection once again became widely accepted by the public (Garment, Lederer, & Rogers, 2007).

A recent study conducted by McBride and Drake (2018) surveyed allopathic medical schools in the United States and reported that all of the 66 schools that responded to the survey utilized cadavers in their gross anatomy course. However, the limitations of cadaveric dissection have been well documented. A shortage of cadavers continues to limit the amount of dissections that can be performed (Aziz et al., 2002). Additionally, there is a lack of trained anatomists to guide student dissections (Aziz et al., 2002). Some anatomists have commented on potential health hazards posed by the

embalming fluid and the risk of infectious disease transmission from cadaver to student (Aziz et al., 2002; McLachlan & Patten, 2006). The cost of cadaver storage, maintenance, and administrative staff can place financial strain on an institution (McLachlan, Bligh, Bradley, & Searle, 2004; McLachlan & Patten, 2006). Even the quality of the learning experience provided by dissection has been called into question as the body colors and textures are altered by fixation processes (McLachlan et al., 2004). Finally, due the rapid expansion of medical knowledge required for medical students to acquire (Rizzolo, 2002) there remains less time for students to complete dissections. This is a major restriction given the time-intensive nature of dissection (Aziz et al., 2002).

These shortcomings have led to the implementation of alternative teaching methods (Losco, Grant, Armson, Meyer, & Walker, 2017). Computer assisted modules (Lewis, 2003; Venkatiah, 2010), 3D printed models (Lim, Loo, Goldie, Adams, & McMenamin, 2016), clay modeling (Bareither et al., 2013; Kooloos, Schepens-Franke, Bergman, Donders, & Vorstenbosch, 2014), and virtual reality (Codd & Choudhury, 2011) have all been used to partially or completely replace traditional dissection. Some anatomists prefer to utilize ultrasound (Hammoudi et al., 2013; Jurjus et al., 2014) and living anatomy, claiming that these are more appropriate methods of teaching medical gross anatomy because it is how most physicians will primarily view their patients (McLachlan & Patten, 2006).

Despite the limitations of cadaveric dissection and the availability of alternative methods, many anatomists insist that the use of dissection is critical to the teaching of anatomy and offers unique benefits to health professional students. In addition to exposure to anatomical content, students are able to visualize 3D structures and relationships (Aziz et al., 2002; Flack & Nicholson, 2018; Granger, 2004; Kotzé & Mole, 2013), discover anatomical variability between donors (Aziz et al., 2002; Cahill, Leonard, Weiglein, & von Lüdinghausen, 2002; Ellis, 2001; Flack & Nicholson, 2018; Granger, 2004; Kotzé & Mole, 2013; Parker, 2002), practice the use of instruments and mechanical skills (Ellis, 2001; Flack & Nicholson, 2018; Granger, 2004; Hussein, Dany, Forbes, Thompson, & Jurjus, 2015; Kotzé & Mole, 2013; Parker, 2002), and work as part of team (Aziz et al., 2002; Ellis, 2001; Flack & Nicholson, 2018; Granger, 2004; Hussein et al., 2015; Kotzé & Mole, 2013; Lempp, 2005). Additionally, cadaver dissection allows for a tactile experience of the tissues of the human body (Aziz et al., 2002; Cahill et al., 2002; Flack & Nicholson, 2018; Granger, 2004), introduces students to the doctor-patient relationship (Granger, 2004), allows for the visualization of various pathologies

(Cahill et al., 2002; Flack & Nicholson, 2018; Parker, 2002), and encourages the development of professionalism and leadership skills (Pawlina & Lachman, 2004).

Hanna and Freeston (2002) reported that medical students agree that the dissection experience lends itself to the improvement of manual dexterity, the appreciation of anatomical variation, and development of teamwork skills. According to Chapman, Hakeem, Marangoni, and Prasad (2013) medical students have also rated dissection above models, software, lectures, living anatomy, radiology, and prosections in order to achieve the following objectives: instill anatomical knowledge, observe three dimensional relationships and donor variability, encourage self-directed learning, encourage learning from experiences, and appreciate clinical anatomy. Furthermore, as many as 87%-95% of students have reported that dissection is necessary to learn gross anatomy (Snelling, Sahai, & Ellis, 2003; Sándor, Birkás, & Győrffy, 2015) and at least 90% of the students in a gross anatomy course found dissection to be an exciting or interesting experience (Bernhardt, Rothkötter, & Kasten, 2012; Hussein et al., 2015; Mc Garvey, Farrell, Conroy, Kandiah, & Monkhouse, 2001). Many studies have confirmed that overall, the majority of students find dissection to be a positive experience (Dinsmore, Daugherty, & Zeitz, 2001; Leboulanger, 2011; O'carroll, Whiten, Jackson, & Sinclair, 2002; Quince, Barclay, Spear, Parker, & Wood, 2011; Vijayabhaskar, Shankar, & Dubey, 2005).

In addition to the perceived benefits and the positive accounts of students, cadaveric dissection is also valued as an introduction to death and dying issues (Granger, 2004; Hanna & Freeston, 2002). Dissection brings the typical student to what is perhaps their closest encounter to human mortality (Aziz et al., 2002) and encourages them to consider their ideas and beliefs about death and dying (Charlton & Smith, 2000; Plaisant et al., 2011; Rizzolo, 2002). Through questionnaires, Penney (1985) found that cadaveric dissection motivated thoughts of mortality, the death of loved ones, and life after death in medical students. Mc Garvey, Farrell, Conroy, Kandiah, and Monkhouse (2001) confirmed these findings and reported that medical gross anatomy dissection provoked thoughts of death in 55.8% of students, thoughts of the death of a friend in 33.7%, and thoughts of their own death in 41.8% of students. Some anatomists view this as an opportunity for students to develop mechanisms, such as detached concern, to cope with death and dying (Charlton & Smith, 2000). Ellis (2001) reasons that dissection "acclimatizes the student to the reality of death" (p. 150). Likewise, Parker (2002)

reports that the experience helps students to become more "familiar with death, and comfortable with the physical reality of a dead body" (p. 911).

Negative Reactions to Dissection

While many positive aspects of dissection have been well documented in the literature, there have also been a myriad of both physiological and psychological negative reactions reported. Anxiety is the most prevalent adverse reaction reported, with anywhere between 13% to 81% of students experiencing anxiety at some point during a cadaveric dissection course (Bernhardt et al., 2012; Chang, Kim, Lee, & Uhm, 2018; Criado-Álvarez et al., 2017; Hancock, Williams, & Taylor, 1998; Horne, Tiller, Eizenberg, Tashevska, & Biddle, 1990; Hussein et al., 2015; Naz et al., 2011; Penney, 1985; Plaisant et al., 2011; Quince et al., 2011; Russa & Mligiliche, 2014; Wisenden et al., 2018).

Anxiety is defined as fear and apprehension accompanied by physiological manifestations and is considered to contribute to stress (Putwain, 2007). Anxiety and stress are inherently unpleasant experiences which have been associated with negative outcomes. Student stress has been associated with poor academic performance (Akgun & Ciarrochi, 2003; Sohail, 2013; Stewart, Lam, Betson, Wong, & Wong, 1999), academic dishonesty (Dyrbye, Thomas, & Shanafelt, 2005), and lower memory capabilities (Rutledge et al., 2009). High stress can also be detrimental to personal and professional relationships (Shapiro, Schwartz, & Bonner, 1998) and can lead to student burnout (Humphris et al., 2002) and even substance abuse (Dyrbye et al., 2005). Furthermore, chronic stress has been shown to have physiological manifestations such as suppression of the immune system (Maddock & Pariante, 2001). Each of these consequences has the potential to hinder a students' quality of life and ability to successfully advance through their education. Therefore, management of these reactions to dissection is important in order to protect against these negative outcomes. Additional physiological and psychological reactions to cadaveric dissection have been reported below (Table 1).

Table 1. Negative Reactions to Cadaveric Dissection

Negative Reaction	Citations
Nausea	(Dinsmore et al., 2001; Getachew, 2014; Hussein et al., 2015; Mc Garvey et al., 2015; Penney, 1985; Russa & Mligiliche, 2014; Saylam & Coskunol, 2005; Singroha, Verma, Malik, Chhikara, & Yadav, 2017; Snelling et al., 2003)
Fear	(Criado-Álvarez et al., 2017; Dinsmore et al., 2001; Hancock et al., 1998; Khan & Mirza, 2013; Kotzé & Mole, 2013; Naz et al., 2011; Russa & Mligiliche, 2014; Singroha et al., 2017; Tseng & Lin, 2016)
Insomnia	(Finkelstein & Mathers, 1990; Getachew, 2014; Mc Garvey et al., 2015; Penney, 1985; Russa & Mligiliche, 2014; Saylam & Coskunol, 2005; Snelling et al., 2003)
Nightmares	(Alt-Epping et al., 2014; Dempster, Black, McCorry, & Wilson, 2006; Finkelstein & Mathers, 1990; Kotzé & Mole, 2013; Naz et al., 2011; Penney, 1985; Singroha et al., 2017)
Loss of Appetite	(Alt-Epping et al., 2014; Dempster et al., 2006; Getachew, 2014; Penney, 1985; Russa & Mligiliche, 2014; Saylam & Coskunol, 2005; Singroha et al., 2017)
Dizziness	(Getachew, 2014; Mc Garvey et al., 2015; Saylam & Coskunol, 2005; Singroha et al., 2017; Snelling et al., 2003)
Fainting	(Alt-Epping et al., 2014; Getachew, 2014; Mc Garvey et al., 2015; Snelling et al., 2003)
Recurring Images	(Finkelstein & Mathers, 1990; Leboulanger, 2011; Snelling et al., 2003; Sándor et al., 2015)
Sweating	(Getachew, 2014; Russa & Mligiliche, 2014)
Disgust	(Penney, 1985; Russa & Mligiliche, 2014)
Vomiting	(Kotzé & Mole, 2013; Mc Garvey et al., 2015)
Eye/Throat Irritation	(Khan & Mirza, 2013; Saylam & Coskunol, 2005)
Avoidance	(Hancock, Williams, & Taylor, 2004; Naz et al., 2011)
Intrusive Thoughts	(Hancock et al., 2004)

Students have reported that specific regional dissections are more challenging than others. Dissections of the face, head, hands, genitals, and female chest specifically have been difficult for students (Finkelstein & Mathers, 1990; Flack & Nicholson, 2018; Moxham, Plaisant, Lignier, & Morgan, 2019; Snelling et al., 2003) as these regions are reminders of a cadavers' humanness (Fortunato, Hankin, & Wasserman, 2018). Enduring the smell of the cadaver lab has proven challenging for others (Criado-Álvarez et al. 2017; Getachew, 2014; Kotzé, 2013; Leboulanger, 2011; Romo Barrientos et al., 2019; Snelling et al., 2003). For some students simply the sight of the cadaver's face is upsetting (Gustavson, 1988). For others, making cuts on the donor, the first cut in particular, is difficult (Gustavson, 1988; Russa & Mligiliche, 2014). Hussein et al. (2015) reported that 35% of medical students in a gross anatomy course found the concept of human mortality frightening.

Certain groups appear to be at higher risk for experiencing negative reactions to cadaveric dissection. Females in particular have reported more fear, anxiety, apprehension, concern, and mental distress in response to dissection (Alt-Epping et al., 2014; Böckers, Baader, Fassnacht, Öchsner, & Böckers, 2012; Hancock et al., 1998; Moxham et al., 2019; Quince et al., 2011; Russa & Mligiliche, 2014; Singroha et al., 2017; Snelling et al., 2003). Additionally, females have higher rates of avoidance behaviors as determined by the Impact of Life Events Scale (Hancock et al., 2004). The discrepancy between male and female reactions can be quite large. Alt-Epping et al. (2014) found that 73% of females were afraid before dissection compared to only 27% of males. Likewise, Plaisant et al. (2011) found that 48% of females were anxious about cadaveric dissection compared to only 18% of males. Only one study has found no difference between the stress levels of males and females prior to dissection, yet even then, males reported feeling more prepared to handle dissection (Leboulanger, 2011). Younger students and non-white, non-Christian students have also been shown to experience higher levels of stress in cadaveric laboratories (Russa & Mligiliche, 2014; Wisenden et al., 2018). Personality and previous exposure to a dead body have also been shown to correlate with anxiety in the cadaver lab. The Big Five personality traits of low extraversion, low altruism, high conscientiousness, high neuroticism, and high open-mindedness have all been associated with higher anxiety (Plaisant et al., 2011). There is disagreement about how prior exposure to a dead body affects students' reactions to dissection. Two studies have shown that students who had seen a dead body prior to dissection were less apprehensive and had significantly fewer negative symptoms (Hancock et al., 1998;

Russa & Mligiliche, 2014). Similarly, prior to the first dissection in medical school, students who had completed at least one dissection were six times less likely to report feeling anxious compared to students who had never completed a dissection (Quince et al., 2011). Horne et al. (1990) reported conflicting results which stated that prior experience with a dead body seemed to sensitize students to the experience, resulting in significantly more adverse psychological reactions.

While specific groups of students seem to be at a higher risk of experiencing negative reactions to dissection, the timing of these reactions seems to be somewhat consistent, with negative reactions peaking just before or during the first dissection and then decreasing with following exposures. Fear and anxiety have been shown to decrease significantly immediately following the first dissection (Arráez-Aybar, Casado-Morales, & Castaño-Collado, 2004; Boeckers et al., 2010; Chang et al., 2018; Wisenden et al., 2018). Some studies have found students' stress and anxiety was significantly reduced after the first week of dissection (Hancock et al., 2004; Snelling et al., 2003) while others have shown these and other symptoms are significantly reduced by the end of the gross dissection course (Criado-Álvarez et al., 2017; Flack & Nicholson, 2018; Kotzé & Mole, 2013; Mc Garvey et al., 2001; Plaisant et al., 2011; Romo Barrientos et al., 2019; Singroha et al., 2017). Penney (1985) found that the number of students reporting apprehension about dissection was reduced from 65% at the beginning of the course to 14% at the end. Hussein et al. (2015) reported similar findings with 43% of students reporting that dissection was anxiety-provoking at the beginning of the course and only 15% at the end. In a qualitative study by Fortunato et al. (2018), researchers confirmed that many students initially experience feelings of anxiety but with continued exposure to dissection, students' comfort level increases. This reduction of symptoms may be attributed to students' development of coping mechanisms (Tseng & Lin, 2016).

A wide range of coping mechanisms have been utilized to manage negative reactions to dissection. Students have reported the use of humor (Gustavson, 1988; Hancock et al., 1998; Kotzé & Mole, 2013; Mc Garvey et al., 2001), the practice of cadaver naming (Williams, Greenwald, Soricelli, & DePace, 2014), and getting help or advice from others (Hussein et al., 2015). Others rely on focusing specifically on the mechanical task of dissection (Getachew, 2014; Mc Garvey et al., 2001) or practicing detached concern (Francis & Lewis, 2001; Kotzé & Mole, 2013; Tseng & Lin, 2016). Students may also find comfort in religion and prayer (Getachew, 2014; Hancock et al., 2004; Hussein et al., 2015; Kotzé & Mole, 2013) or visualizing their future as a doctor as

a way to justify the dissection process (Kotzé & Mole, 2013). Robbins (2018) claims that in order to cope with dissection, medical students are subtly trained to view death simply as a malfunction of the human body, rather than acknowledge the existential aspects of death, and that this training promotes a denial of death that continues as students become physicians.

A number of interventions have also been implemented to aid students in coping with the dissection experience. Khan and Mirza (2013) implemented an orientation session prior to dissection which outlined the source of cadavers, methods of disposal, and the advantages of dissection. Students receiving this orientation reported significantly fewer symptoms compared to those who did not. Saylam and Coskunol (2005) found that students participating in a discussion covering the source of donors, parallels between donor and patients, and philosophies of life and death performed better on examinations but did not have significantly different levels of anxiety compared to the control group. Another intervention attempted to humanize cadavers by giving students more information about the donor's life (Wisenden et al., 2018). While this decreased anxiety in minority students, it had the unexpected consequence of increasing anxiety in females. Tschernig, Schlaud, and Pabst (2000) implemented an introduction to death and dying, followed by small group discussions used to help students explore their expectations and fears before entering the dissection lab.

Findings on the effectiveness of educational films utilized to prepare students for cadaveric dissection have been mixed. Arráez-Aybar et al. (2004) found that students who watched a video preparing them for the cadaver lab had lower anxiety about dissecting. Casado et al. (2012) demonstrated similar results, showing significantly lower anxiety in students who viewed a video about dissection prior to entering the cadaver lab. In another study, viewing a short documentary was associated with more positive reactions toward the cadaver but also a more negative attitude toward dissection (Dosani & Neuberger, 2016). In another example, watching an educational film prior to dissection showed no significant difference in students' psychological stress (Iaconisi et al., 2019). Other interventions developed to decrease negative reactions include inviting third year medical students to aid first year students on their first day of dissection (Houwink et al., 2004), playing background music in the dissection laboratory (Anyanwu, 2015), and gradually introducing students to prosections before they begin dissection (Böckers et al., 2012).

Fear of Death and Death Anxiety

A wide variety of negative reactions to cadaveric dissection have been well described in the literature. However, the instruments used in many of these studies are unlikely to specifically detect changes in students' attitudes and ideas about death and dying that are brought about by such a personal and profound experience with death. Fear of death and death anxiety measures may provide more specific insight into this change. In the past, the terms fear of death and death anxiety have been distinguished from one another with fear stemming from a clear threat and anxiety arising from feelings of uncertainty (Nyatanga & de Vocht, 2006). However, many researchers use these terms interchangeably (Neimeyer & Moore, 1994). The definition of these terms typically varies based on the scale being used to measure these concepts. Death anxiety has been described as "an unpleasant emotion of multidimensional concerns that is of an existential origin provoked on contemplation of self or others" (Nyatanga & de Vocht, 2006, p. 412) and the anxiety caused by the inevitability of death (Lehto & Stein, 2009). In the current study, we will use the definition provided by Hoelter (1979) which states that fear of death is "an emotional reaction involving subjective feelings of unpleasantness and concern based on contemplation or anticipation of any of the several facets related to death. It is also assumed that these feeling are largely conscious" (p. 996).

Using a variety of death anxiety and fear of death scales, trends have been identified in the general population for certain groups. Females typically have a higher fear of death compared to males (Pierce Jr, Cohen, Chambers, & Meade, 2007). Younger samples have higher fear of death compared to older samples (Nienaber & Goedereis, 2015; Thorson & Powell, 1988) with the exception of a secondary peak in females' death anxiety around age fifty (Russac, Gatliff, Reece, & Spottswood, 2007).

Fear of death has been investigated in medical and dental student populations, as well as in clinical care settings. It is important to understand fear of death in these groups because they are likely to have "more frequent and more intense contact with death and dying" (Howells & Field, 1982, p. 1421). When compared to a sample of the general population, medical students actually report significantly lower levels of fear of death (Thorson & Powell, 1991). When compared to other graduate level students, medical student fear of death has been shown to be significantly lower (Jordan, Ellis, & Grallo, 1986) or not significantly different (Howells & Field, 1982). Medical students have even demonstrated lower fear of death when compared to dental students (Sundin,

Gaines, & Knapp, 1980). In the medical and dental student population, fear of death and death anxiety have been shown to remain relatively stable throughout their four to six years of training (Sundin et al., 1980; Thiemann, Quince, Benson, Wood, & Barclay, 2015; Thorson & Powell, 1991). However, some medical students' death anxiety has been shown to change from the beginning to the end of a gross anatomy course with cadaveric dissection. By the end of the course, death anxiety decreased in 54% of the students, increased in 29%, and did not change in 18% (Dickinson, Lancaster, Winfield, Reece, & Colthorpe, 1997).

Just as in the general population, fear of death in female medical students is significantly higher than male medical students' fear of death (Dickinson et al., 1997; Howells & Field, 1982; Quince et al., 2011). Other fear of death trends identified in medical students highlight associations between fear of death, psychological factors, and prior experience. Medical students with higher fear of death are more likely to experience higher levels of general anxiety and depression (Thiemann et al., 2015), rate higher on the neuroticism trait of the Big Five personalities (Howells & Field, 1982), and are more likely to have an external locus of control (Vargo & Black, 1984). Furthermore, a higher fear of death in medical students taking cadaveric dissection is associated with not feeling prepared for dissection, an increased likelihood of experiencing thoughts about dying (Arráez-Aybar, Castaño-Collado, & Casado-Morales, 2008), increased anxiety about dissecting, and a higher likelihood of becoming upset when remembering that the donor was once a person (Quince et al., 2011). However, medical students' fear of death does not seem to be associated with prior exposure to a dead body (Quince et al., 2011).

In the clinical care setting, fear of death and death anxiety have been shown to be associated with the quality of care received by patients. This has primarily been investigated in nursing populations. Peters et al. (2013) found that nurses with higher death anxiety have a more negative attitude toward caring for dying patients. Similarly, Deffner and Bell (2005) reported that nurses with higher death anxiety are less comfortable communicating with patients and families about issues surrounding death and dying.

Because higher fear of death has been shown to correlate with other negative factors, courses have been developed in order to decrease participants' fear of death. Semester long courses that included lectures and readings have been shown to significantly lower fear of death in human services students (McClatchey & King, 2015),

undergraduate nursing students (Mooney, 2005), and a class of general university students (Wong, 2009). Another semester long course that consisted of viewing and discussing the television show *Six Feet Under* (Ball & Janollari, 2001), which is primarily focused on death and dying issues, also showed a significant decrease in some aspects of fear of death (Schiappa, Gregg, & Hewes, 2004). Death and dying courses have been designed and implemented in medical schools as well. The University of Massachusetts and Dalhousie University have been leading death and dying courses and discussions for many years in order to help their students consider and establish their views on these sensitive issues (Marks Jr et al., 1997). Hegedus, Zana, and Szabó (2008) also implemented a death and dying course for medical students but found that while fear of death decreased, the change did not reach significance.

Multidimensional Fear of Death Scale

During the 1970s there was an exponential increase in the interest paid to fear of death which resulted in the publication of many scales and surveys to measure this concept (Neimeyer, Wittkowski, & Moser, 2004). At first, scales were primarily unidimensional and measured death anxiety or fear of death as a single general concept. Later, fear of death was studied using multidimensional scales that measured specific dimensions of fear of death. Hoelter (1979) constructed the Multidimensional Fear of Death Scale (MFODS) specifically for this purpose. The scale consists of eight individual factors which each assess a specific aspect of apprehension about death and dying. The titles and descriptions of the factors provided by Neimeyer and Moore (1994) are listed below:

F1: Fear of the Dying Process (including painful and violent deaths)

F2: Fear of the Dead (including avoidance of both human and animal remains)

F3: Fear of Being Destroyed (including dissection and cremation of the body)

F4: Fear for Significant Others (including apprehension about the impact of the respondent's death on significant others and of their deaths on the respondent)

F5: Fear of the Unknown (including fear of nonexistence)

F6: Fear of Conscious Death (including anxieties about falsely being declared dead)

F7: Fear for the Body After Death (including concern about decay and isolation of the body)

F8: Fear of Premature Death (including concern that death will prevent one from accomplishing important life goals or having significant experiences)

Many of the trends described for general fear of death and death anxiety have been confirmed with the MFODS. Females tend to have higher fear of death as measured by the MFODS compared to males (Cicirelli, 2001; Missler et al., 2012; Tang, Wu, & W. Yan, 2002; Zana, Szabó, & Hegedűs, 2009). Age is also negatively correlated with fear of death when using the MFODS measure (Cicirelli, 2001, 2006; Nienaber & Goedereis, 2015; Zana et al., 2009). This age trend has even been reported in a college population with a much smaller age range. When using the MFODS, younger college students tend to have higher fear of death as compared to older college students (Chen, Del Ben, Fortson, & Lewis, 2006; Tang et al., 2002). MFODS fear of death is also positively correlated with other undesirable characteristics. Higher fear of death is associated with lower self-esteem, social support, religiosity (Cicirelli, 2002) and self-efficacy (Fry, 2003; Tang et al., 2002).

Aims and Hypotheses

The cadaveric dissection experience often prompts students to consider death and dying issues, however, the impact of this personal encounter with death remains largely unknown. Therefore, the current study aimed to answer the following research question: In a gross anatomy course with cadaveric dissection, is there a relationship between fear of death, dissection avoidance behaviors, and performance throughout the semester? This question was addressed using the following aims:

1. *Describe how gross anatomy students' fear of death changes with continued exposure to cadaveric dissection.* The Multidimensional Fear of Death Scale (MFODS) was used to measure students' fear of death. Students completed the scale before the first dissection and just before each of the block exams. We hypothesized that medical students' fear of death would decrease with continued exposure to cadaveric dissection.
2. *Describe the relationship between students' fear of death, cadaveric dissection avoidance behaviors, and gross anatomy performance.* Students' fear of death was assessed multiple times over the course of the semester using the MFODS. Dissection avoidance behaviors were assessed using a questionnaire. These

variables were then correlated to academic performance using written and practical examination scores. We hypothesized that higher fear of death would be positively correlated with avoidance behaviors in the dissection lab and lower academic performance.

Summary

Cadaveric dissection continues to be an integral part of gross anatomy education and offers many unique benefits and opportunities to students. However, a wide variety of negative reactions to cadaveric dissection have been reported and the impact that this personal encounter with death has on students' fear of death remains largely unknown. The current study aimed to address this gap by describing how medical and dental students' fear of death changes with continued exposure to cadaveric dissection. Furthermore, we aimed to describe the relationship between students' fear of death, dissection avoidance behaviors, and gross anatomy performance. This relationship is particularly important to understand in gross anatomy courses as this experience may bring thoughts concerning death and dying to the forefront of students' minds as they strive to master anatomical content. Understanding these relationships could allow instructors to implement interventions to reduce fear of death and improve performance in gross anatomy. Possible interventions may include a death education course, as they have been shown to significantly lower fear of death. Ultimately, this would allow for anatomy faculty members to further support their students both emotionally and academically.

METHODS

Context

The University of Mississippi Medical Center (UMMC) is a large academic medical center in the southeastern United States which supports a three part mission of education, research, and patient care. The educational mission is supported through the training of future healthcare providers in the schools of medicine, dentistry, pharmacy, nursing, allied health science, population health, and graduate studies. Enrollment between all seven programs totals over 3,000 students.

Dental Gross Anatomy

The UMMC dental school is currently the only program in the state of Mississippi and typically only accepts in-state residents. At the time of this study, students in the first year of the program took the following courses: Gross Anatomy, Microscopic Anatomy, Biochemistry, Basic Life Support, and various other dental morphology, pathology, and treatment courses.

During the 2018-2019 school year, Dental Gross Anatomy was taught by concurrent lecture and laboratory courses, both using a regional approach. Block one covered skull osteology and was taught for three weeks during the fall semester. During this time, the students did not use the cadaver laboratory. The remaining thirteen weeks of the course were taught during the spring semester. Block two covered back and upper extremity, block three covered thorax, abdomen, neck, and face, and block four focused on the face and head.

The lecture course consisted of 60 contact hours which the School of Dentistry equates to five credit hours. Content was delivered primarily through didactic lectures taught by faculty members as well as clinical correlation lectures presented by dentists. Lectures were typically scheduled for two hours three times a week and attendance was mandatory. *Gray's Anatomy for Students* (Drake, Vogl, & Mitchell, 2009) and *The Anatomical Basis of Dentistry* (Liebgott, 2009) were required texts for the course. Lecture grades were assigned using the following grading scale: A = 90.0-100.0%, B = 80.0-89.9%, C = 70.0-79.9%, F = <70.0%. Lecture grades were determined by four examinations and ten quizzes. Examinations consisted of 100 multiple choice questions and were administered using ExamSoft® software (www.examsoft.com). Quizzes were made available at the beginning of lectures through Canvas Learning Management Software (www.instructure.com/canvas/) and occurred once every three lectures. Quizzes consisted of ten true/false questions. Immediately following each quiz, a faculty

member discussed the questions and answers with the class. Out of twelve quizzes, only the ten highest scores were included in each student's final grade. Table 2 indicates the weight of each lecture assessment as it contributed to the final grade.

Table 2. Dental Gross Anatomy Lecture Grade

Assessment	Subject	% of Final Grade
Fall Exam 1	Osteology	10
Spring Exam 1	Back, upper extremity	25
Spring Exam 2	Neck, thorax and abdomen, Face 1	25
Spring Exam 3	Face 2, Head	30
Quizzes	As scheduled	10

The laboratory course was 88 contact hours which equated to seven credit hours. Laboratory sessions were typically scheduled for two to three hours three times a week and attendance was mandatory. In the laboratory course, students were split into groups of four and assigned to a table with a cadaver. A table leader was selected by the course director for the first cadaveric laboratory block based on prior anatomy experience. Following the first block, groups elected a different table leader for each block. Responsibilities of the table leader included: outlining the dissection plan, assigning tasks to other group members, ensuring dissection was progressing on schedule, acting as a liaison between faculty and group members, ensuring all checklist structures are dissected, and assigning roles for peer-to-peer review sessions held before each block exam. *Grant's Dissector* (Tank, 2012) was used by students to guide each of the dissections. Faculty members were assigned to groups of tables and assisted with dissection and identification of structures. Prosections completed by past medical and graduate students were also available as a supplementary learning tool.

Laboratory grades were assigned using the following grading scale: A = 90.0-100.0%, B = 80.0-89.9%, C = 70.0-79.9%, F = <70.0%. Laboratory grades were determined by four practical examinations and were administered on the same day as the lecture examinations. Practical examinations consisted of 50 tagged structures on the

dissected cadavers, prosections, and bones. The majority of questions were first order and only required identification of the tagged structure. Only a few bone questions were second order and required identification, action, or innervation of the muscle which attached at the tagged structure. Table 3 indicates the weight of each laboratory assessment as it contributed to the final grade.

Table 3. Dental Gross Anatomy Laboratory Grade

Assessment	Subject	% of Final Grade
Fall Exam 1	Osteology	15
Spring Exam 1	Back, upper extremity	25
Spring Exam 2	Neck, thorax and abdomen, Face 1	25
Spring Exam 3	Face 2, Head	35

Medical Gross Anatomy

The medical school at UMMC typically only accepts in-state residents and is the state's only allopathic medical program. At the time of this study, the curriculum included two years of basic science training followed by a two year clinical phase. In the first year of medical school Gross Anatomy, Histology and Cell Biology, Developmental Anatomy, Biochemistry, Physiology, Neuroscience, and Introduction to the Medical Profession were taught as separate, required courses.

During the 2019-2020 school year, Medical Gross Anatomy was taught as a single 16 week course with lecture and laboratory components. The course spanned over four blocks which covered the following topics using a regional approach: back and upper extremity, thorax and abdomen, pelvis and lower extremity, and head and neck. The course consisted of 170 contact hours which the School of Medicine equated to 12 credit hours. There was an average of three 1-hour lectures per week. Faculty members presented didactic lectures which were not mandatory for students to attend while physicians presented clinical correlation lectures that were mandatory. The required text for the course was *Gray's Basic Anatomy* (Drake, Vogl, & Mitchell, 2012).

Laboratory sessions were 3 hours and typically scheduled to meet three to four times a week. Medical students were divided into groups of six students per table. Each

table was then further split into A and B groups which alternated dissection responsibilities. The groups that did not dissect were to attend small group radiology sessions, learn clinical skills such as taking blood pressure, or were encouraged to participate in self-study. The group that dissected was then responsible for peer-teaching the group that did not dissect. During laboratory sessions, students did not have assigned roles within their groups and therefore were able to choose their participation level. Electronic dissection modules (Thieme, 2013) were used to guide dissections and *The Atlas of Anatomy* (Gilroy, MacPherson, & Ross, 2008) was available for reference. Faculty members were assigned to groups of tables and assisted with dissection and identification of structures. Graduate teaching assistants were also available and typically assisted student groups from all sections. Prosections were supplementary for many lab sessions except for difficult to dissect regions such as the hands, feet, and some joints. In these cases, students did not dissect and instead relied on prosections to learn the required structures from these regions.

In addition to lecture and laboratory, students were also required to attend activity sessions and take oral quizzes approximately once a week. The activity sessions provided practice questions, worksheets, educational games, and drawings to review the material covered during the previous week. While half the students attended the activity session, the other half were scheduled to complete oral quizzes in the cadaver laboratory. Oral quizzes were administered to each table by a faculty member. Two randomly selected group members from each table were verbally read a question and were required to answer the question by identifying the necessary structure on their group's cadaver. After one half of the class had been quizzed, they went to the activity session while the other half began their quizzes.

Letter grades were assigned in the medical gross anatomy course using the following grading scale: A = 90.0-100.0%, B = 80.0-89.9%, C = 70.0-79.9%, F = <70.0%. Grades were determined by four written and practical examinations, four radiology quizzes, oral quizzes, and the National Board Subject Exam taken at the conclusion of the semester. Written examinations consisted of approximately 80 multiple choice questions and were administered using ExamSoft® software (www.examsoft.com). Practical examinations consisted of approximately 60 tagged structures on the dissected cadavers, prosections, and bones. Students were allowed one minute at each question before they were alerted to move to the next question by a timer. Questions were primarily first order which required identification of the tagged structure. There were also several

second order questions which required the action or innervation of a tagged structure. Radiology quizzes consisted of five multiple choice questions and were available to students through learning management software. A radiology quiz was required to be completed before each block examination. Table 4 indicates the weight of each assessment as it contributed to the final course grade.

Table 4. Medical Gross Anatomy Grade

Assessment	Subject	% of Final Grade
Exam 1	Back, upper extremity	20
Exam 2	Thorax, abdomen	20
Exam 3	Pelvis, lower extremity	20
Exam 4	Head, neck	20
Radiology Quizzes	As scheduled	5
Oral Laboratory Quizzes	As scheduled	5
National Board Subject Exam	Cumulative	10

Measures

The majority of data were collected using two types of surveys. The initial survey was given before the students' first cadaveric lab experience and the follow-up survey was administered just prior to each block exam. The initial survey (Appendix A) asked students to provide demographic information including the student's name, program of study, age, sex, undergraduate GPA, and entrance exam scores (DAT for dental students and MCAT for medical students). The initial survey was modified for the medical students to more accurately reflect gender identity. Specifically, medical students were asked to provide their gender, rather than sex. Transgender male and transgender female were also added as options to this question. The initial survey also asked students to report the number of prior anatomy courses they had taken (none, one, two, three or more) and the type of anatomy courses they had taken (lecture only, lecture with models, lecture with animal dissection, comparative anatomy, lecture with prosections, lecture

with dissection). These final two items and available options were based on the items used by Kondrashov, McDaniel, and Jordan (2017).

With the initial survey, students also completed three subscales from the Multidimensional Fear of Death Scale (MFODS) (Hoelter, 1979). The three subscales were chosen from the available eight because items from these subscales were most closely related to the cadaveric dissection experience. The included subscales were Fear of the Dead with six items, Fear of Being Destroyed with four items, and Fear for the Body After Death with six items. The MFODS has been proven to have strong internal consistency with a mean Cronbach alpha value of $\alpha = .75$ (Hoelter, 1979). Internal consistency of the selected subscales are as follows: Fear of the Dead ($\alpha = .72$), Fear of Being Destroyed ($\alpha = .81$) Fear for the Body After Death ($\alpha = .82$) (Hoelter, 1979). Test-retest reliability was established over a three week interval with Pearson correlation coefficients as follows: Fear of the Dead ($r = .77$), Fear of Being Destroyed ($r = .71$), and Fear for the Body After Death ($r = .81$) (Neimeyer & Moore, 1994). Construct validity has been demonstrated by correlating the MFODS to personal death narratives (Holcomb, Neimeyer, & Moore, 1993) and personal death philosophies (Neimeyer & Moore, 1994). Convergent and discriminate validity has been confirmed by Neimeyer and Moore (1994) through correlations with the Threat Index (Krieger, Epting, & Leitner, 1975).

When completing the selected three subscales students were instructed to indicate to what degree they agreed or disagreed with each item using a scale where 1 = strongly agree, 2 = mildly agree, 3 = neither agree nor disagree, 4 = mildly disagree, and 5 = strongly disagree. Ratings for each item of a subscale were added together to produce a total score for that subscale. Lower scores indicated a higher fear of death and higher scores indicated a lower fear of death.

The follow-up survey (Appendix B) that was administered before each examination asked students to provide their name in order to match responses over time. In order to assess avoidance behaviors in the laboratory, items on the follow-up survey also asked students to select a description that most adequately described their role in dissections (I do the majority of the dissection, dissection is evenly split, I rarely dissect, I never dissect), the percentage of time they spent dissecting and using prosections during lab, and the number of hours they spent in lab outside of scheduled class time. The item asking students to provide percentages is based on the survey given by Winkelmann, Hendrix, & Kiessling (2007) to determine how students use their time in lab. Finally, students were asked to rate five statements concerning avoidance

behaviors such as avoiding the cadaver lab, touching the cadavers, looking at the cadavers, dissecting the cadavers, and thoughts about the donor's life. Each statement was rated from 1 (strongly agree) to 5 (strongly disagree). Avoidance items were developed based on a review of the current literature and existing avoidance measures (Gámez, Chmielewski, Kotov, Ruggero, & Watson, 2011; Weiss, 2007). With each follow-up survey, students also completed the same three MFODS subscales that were on the initial survey. Course directors provided performance data at the end of their courses. This included written exam scores from the lecture exams using ExamSoft® and practical exam scores from the laboratory exams.

Collection Procedure

Anatomy students were approached by the primary researcher during scheduled class time on the day of their first cadaveric dissection lab. All anatomy students were included as there was no exclusion criteria. At the start of class, the survey was verbally introduced to the students and they were informed that completion of the survey was viewed as their consent to participate in the study. In case any part of the study provoked feelings of distress, students were also given a UMMC Wellness Center brochure which outlined resources for free counseling. Students took approximately five minutes to complete the initial survey. All surveys were collected regardless of completion. Follow-up surveys were administered to the dental students two to four days prior to each block exam as it was not feasible to survey them on the day of their exam. However, medical students were able to complete the follow-up survey during the scheduled exam times.

Data collected from the students were entered into Microsoft Excel, version 16.28, by the primary researcher. In order to de-identify the data, names were removed from the dataset after entry into the spreadsheet was complete. This ensured that any of the faculty associated with either of the gross anatomy courses did not have access to individual student responses.

Data Analysis

Demographic information, fear of death, dissection avoidance behaviors, and performance were summarized using descriptive statistics. Pearson correlations were performed using demographics and fear of death subscales. A one-way ANOVA was used to compare fear of death between students with different numbers of prior anatomy

courses and an independent t-test was used to compare fear of death between students who had prior exposure to cadaveric materials and those who did not.

To address the first aim of describing how gross anatomy students' fear of death changes with continued exposure to cadaveric dissection, repeated measures ANOVA was used to compare how each fear of death subscale changed throughout the course. Males' and females' fear of death was compared using independent t-tests. As a follow-up analysis, changes in specific items of the Fear of Being Destroyed subscale were assessed using the Friedman test.

To address the second aim of describing the relationship between students' fear of death, avoidance behaviors in lab, and performance, Pearson correlations were performed between fear of death, lab activities, hours in lab, and exam performance. One-way ANOVA was used to compare fear of death between students who reported having different roles in dissection. Lastly, association between items assessing avoidance behaviors and the fear of death subscales were assessed using ordered logistic regression.

Missing data from individual items from the three MFODS subscales were addressed using mean imputation (Buhi, Goodson, & Neilands, 2008). This procedure utilizes the variable mean value to replace missing values. Participants with incomplete data (those who failed to complete an entire follow-up survey) were excluded from analyses of that survey and analyses of surveys over time. All statistical analyses were completed using SPSS version 24 (IBM Inc., Armonk, NY) with a significance level of $p < 0.05$.

RESULTS

This chapter contains results from the initial survey given at the beginning of the anatomy course and follow-up surveys given at each examination (exam). Dental and medical student data are presented independently. For each cohort, demographic information and preliminary analyses are presented, followed by specific analyses addressing aim 1 and 2 of the study.

Dental Students - Demographics

Thirty-nine out of 40 (97.5%) dental students enrolled during the 2019 spring semester completed the initial survey. At exam 2, one student was not present to complete the follow up survey and at exam 3, four other students were not present to complete the follow up survey. As described in the methods, these students were included only in analyses of time points for which they had complete data. See Table 5 for dental student demographic data.

Table 5. Dental Student Demographics

Gender, n (%)	
Male	20 (51.3)
Female	19 (48.7)
Age, years	
M ± SD	24.56 ± 2.9
Range	22-38
Admissions Variables, M ± SD	
GPA	3.67 ± 0.2
DAT	19.26 ± 1.5

Data concerning prior anatomy experience was collected at the initial survey. Prior coursework experience is presented in Table 6.

Table 6. Dental Student Prior Anatomy Coursework

	Students, n (%)
Number of Prior Anatomy Courses	
None	13 (33.3)
One	11 (28.2)
Two	12 (30.8)
Three or more	3 (7.7)
Type of Prior Anatomy Courses*	
Lecture Only	4 (10.3)
Lecture with Models	14 (36.9)
Lecture with Animal Dissection	5 (12.8)
Comparative Anatomy	4 (10.3)
Lecture with Prosection	9 (23.1)
Lecture with Human Dissection	4 (10.3)

*Some students had more than one type of prior anatomy course and others had none, therefore, percentages in Type of Prior Anatomy Courses will not total 100%.

Dental Students - Preliminary Analyses

At each examination, dental gross anatomy students reported the percentage of time spent actively dissecting, studying prosections, and participating in activities unrelated to cadavers during scheduled lab time. Average percentages can be found in Table 7.

Table 7. Dental Student Lab Activities

Exam	Time in Lab (%), M ± SD
Exam 1	
Dissection	81.13 ± 17.5
Prosection	9.08 ± 10.5
Other	9.79 ± 10.8
Exam 2	
Dissection	72.13 ± 20.7
Prosection	14.94 ± 16.0
Other	12.92 ± 16.27
Exam 3	
Dissection	66.06 ± 28.2
Prosection	9.71 ± 7.7
Other	24.51 ± 27.2

At each of the follow-up surveys students were asked to report a weekly average of the amount of hours they had spent in the cadaver laboratory outside of scheduled class time. Average number of hours are presented in Table 8.

Table 8. Average Hours per Week Dental Students Spent in the Cadaver Lab

Exam	Hours, M ± SD (Range)
Exam 1	0.61 ± 1.1 (0 – 4)
Exam 2	3.02 ± 4.0 (0 – 20)
Exam 3	2.70 ± 2.9 (0 – 12)

Five items were used to collect data concerning students' avoidance behaviors in laboratory at the conclusion of each block. Frequency counts for these items are presented in Table 9.

Table 9. Dental Student Avoidance Behaviors

	Strongly Agree, n (%)	Mildly Agree, n (%)	Neither Agree or Disagree, n (%)	Mildly Disagree, n (%)	Strongly Disagree, n (%)
Exam 1					
I avoid being in the cadaver lab	6 (15.4)	6 (15.4)	12 (30.8)	7 (17.9)	8 (20.5)
I avoid looking at the cadaver	1 (2.6)	5 (12.8)	2 (5.1)	10 (25.6)	21 (53.8)
I avoid touching the cadaver	2 (5.1)	4 (10.3)	1 (2.6)	9 (23.1)	23 (59.0)
I avoid dissecting the cadaver	1 (2.6)	2 (5.1)	3 (7.7)	8 (20.5)	25 (64.1)
I avoid thoughts about the donor's life	11 (28.3)	3 (7.7)	10 (25.6)	8 (20.5)	7 (18.0)
Exam 2					
I avoid being in the cadaver lab	5 (13.2)	6 (15.8)	3 (7.9)	11 (28.9)	13 (34.2)
I avoid looking at the cadaver	0 (0.0)	2 (5.3)	3 (7.9)	9 (23.7)	24 (63.2)
I avoid touching the cadaver	0 (0.0)	3 (7.9)	0 (0.0)	7 (18.4)	28 (73.7)
I avoid dissecting the cadaver	1 (2.6)	2 (5.3)	2 (5.3)	5 (13.2)	28 (73.7)
I avoid thoughts about the donor's life	4 (10.5)	4 (10.5)	13 (34.2)	6 (15.8)	11 (28.9)
Exam 3					
I avoid being in the cadaver lab	4 (11.4)	8 (22.9)	8 (22.9)	5 (14.3)	10 (28.6)
I avoid looking at the cadaver	2 (5.7)	1 (2.9)	7 (20.0)	6 (17.1)	19 (54.3)
I avoid touching the cadaver	3 (8.6)	1 (2.9)	4 (11.4)	7 (20.0)	20 (57.1)
I avoid dissecting the cadaver	3 (8.6)	2 (5.7)	4 (11.4)	4 (11.4)	22 (62.9)
I avoid thoughts about the donor's life	5 (14.3)	1 (2.9)	14 (40.0)	4 (11.4)	11 (31.4)

Dental student fear of death was assessed at each of the three exams using three subscales from the Multidimensional Fear of Death Scale (MFODS). The average subscale scores are reported in Table 10.

Table 10. Dental Student Fear of Death

	Fear of the Dead (M ± SD)	Fear of Being Destroyed (M ± SD)	Fear for the Body After Death (M ± SD)
Initial	18.03 ± 5.0	11.46 ± 3.5	21.94 ± 5.1
Exam 1	18.43 ± 5.0	10.49 ±3.5	21.86 ± 5.1
Exam 2	18.63 ± 5.7	9.81 ± 3.8	22.57 ± 5.6
Exam 3	18.66 ± 5.5	9.94 ±4.0	23.29 ± 5.1

Exam scores were provided by the dental gross anatomy course director at the end of the course. Written and practical exam averages are presented in Table 11.

Table 11. Dental Student Exam Averages

Exam 1 (M ± SD)		Exam 2 (M ± SD)		Exam 3 (M ± SD)	
Written	Practical	Written	Practical	Written	Practical
84.54 ± 7.5	84.13 ± 9.6	79.74 ± 10.1	87.74 ± 6.6	87.55 ± 7.3	89.85 ± 10.2

Pearson correlations were conducted to determine the association between the demographic factors of age, GPA, and DAT and the three fear of death subscales at each time point. For dental students, age and GPA showed significant correlations with fear of death throughout the semester, particularly the Fear of the Dead and Fear of Being Destroyed. Younger age and higher undergraduate GPA were significantly correlated with higher Fear of the Dead and Fear of Being Destroyed. All correlations for dental students are reported in Table 12.

Table 12. Correlations Between Dental Student Fear of Death and Demographic Variables

	Age	GPA	DAT
Fear of the Dead			
Initial	.477**	-.319*	-.061
Exam 1	.509**	-.446**	.027
Exam 2	.486**	-.548**	-.166
Exam 3	.447**	-.383*	.112
Fear of Being Destroyed			
Initial	.282	-.366*	.151
Exam 1	.558**	-.404*	.175
Exam 2	.550**	-.436**	.095
Exam 3	.394*	-.292	.324
Fear for the Body After Death			
Initial	.190	.002	.057
Exam 1	.297	-.147	.205
Exam 2	.335*	-.175	.004
Exam 3	.243	-.007	.323

Note: Higher fear of death scores indicate a lower fear death. An example of how to use this to interpret the above correlations; higher GPA is correlated with lower Fear of the Dead *scores*, meaning higher GPA is correlated with higher Fear of the Dead.
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

One-way ANOVAs were conducted to determine if the number of prior anatomy courses was associated with fear of death at the time of the initial survey. Students' number of prior anatomy courses was not significantly associated with Fear of the Dead (F (3,35) = 2.476, p = .078), Fear of Being Destroyed (F (3,35) = .372, p = .774), or Fear for the Body After Death (F (3,35) = .225, p = .878). Independent t-tests were also run to compare initial fear of death between students' who had prior exposure to human cadaveric specimens and those who had not. There was no significant difference in Fear of the Dead between those with prior exposure (M = 17.62, SD = 5.1) and those without (M = 18.31, SD = 4.6; t (37) = .428, p = .671). Likewise, there was no significant difference in Fear of Being Destroyed between those with prior exposure (M = 11.62, SD = 4.5) and those without (M = 11.23, SD = 3.3; t (37) = -.304, p = .763). There was a significant difference in Fear for the Body After Death with students that had prior

exposure having higher fear (M = 19.42, SD = 6.1) compared to those without prior exposure (M = 23.12, SD = 4.3; t (37) = 2.195, p = .035).

Dental Students - Aim 1

In order to address the first aim of the study, repeated measures ANOVAs were conducted to assess how the three fear of death subscale scores changed throughout the cadaveric dissection portion of the course. Dental students showed no significant changes in Fear of the Dead (F (3, 32) = .374, p = .772) or Fear for the Body After Death (F (3,32) = 1.221, p = .318). However, a significant change was found in students' Fear of Being Destroyed (F (3,32) = 4.683, p = .008). Post-hoc comparisons using the Tukey HSD test indicated the mean Fear of Being Destroyed score significantly decreased (indicating an increase in fear of death on this scale) between the initial (M = 11.46, SD = 3.5) and exam 2 survey (M = 9.81, SD = 3.8). The mean subscale scores for each surveyed time point can be found in Figure 1.

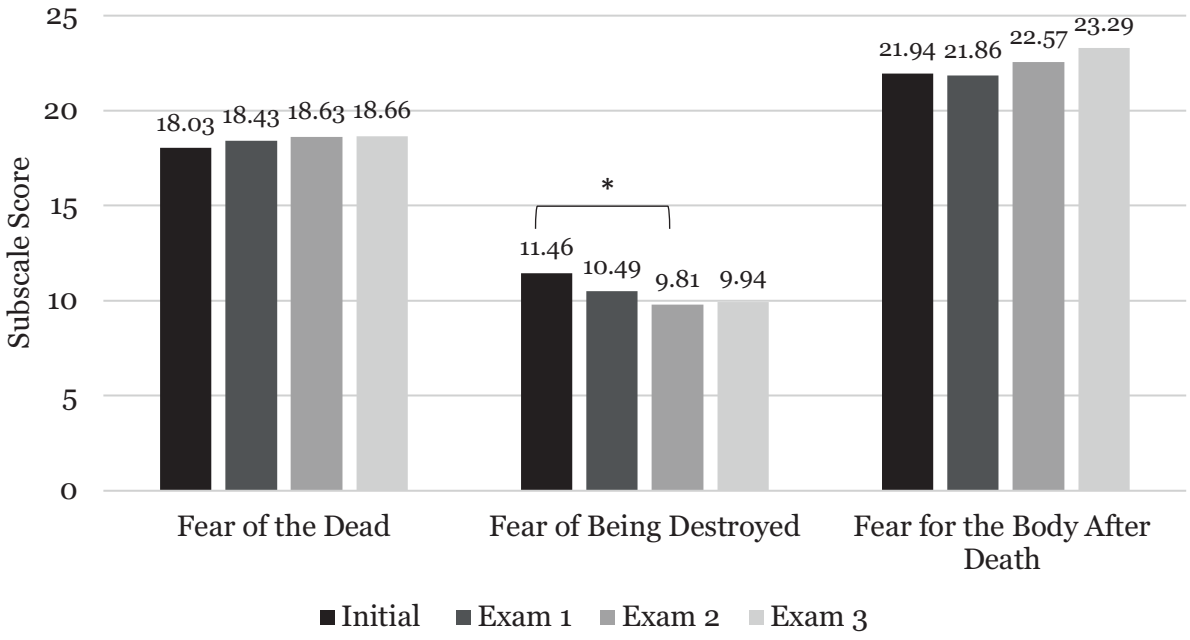

Figure 1. Dental Student Average MFODS Subscale Scores
*Tukeys post hoc test shows significant difference between initial and Exam 2 Fear of Being Destroyed (p<.05).

When separated by gender, there were some significant differences between males' and females' fear of death. Independent t-tests show that compared to male dental students, female dental students had significantly higher Fear of the Dead at the initial survey; t(37) = 2.25, p = .030, exam 1 survey; t(37) = 2.69, p = .011, exam 2

survey; $t(37) = 2.11$, $p = .042$, and exam 3 survey; $t(33) = 2.87$, $p = .007$. This was not the case for Fear of Being Destroyed or Fear for the Body After Death as there were no significant difference between males and females on these subscales. Male and female fear of death subscale scores are shown in Figure 2.

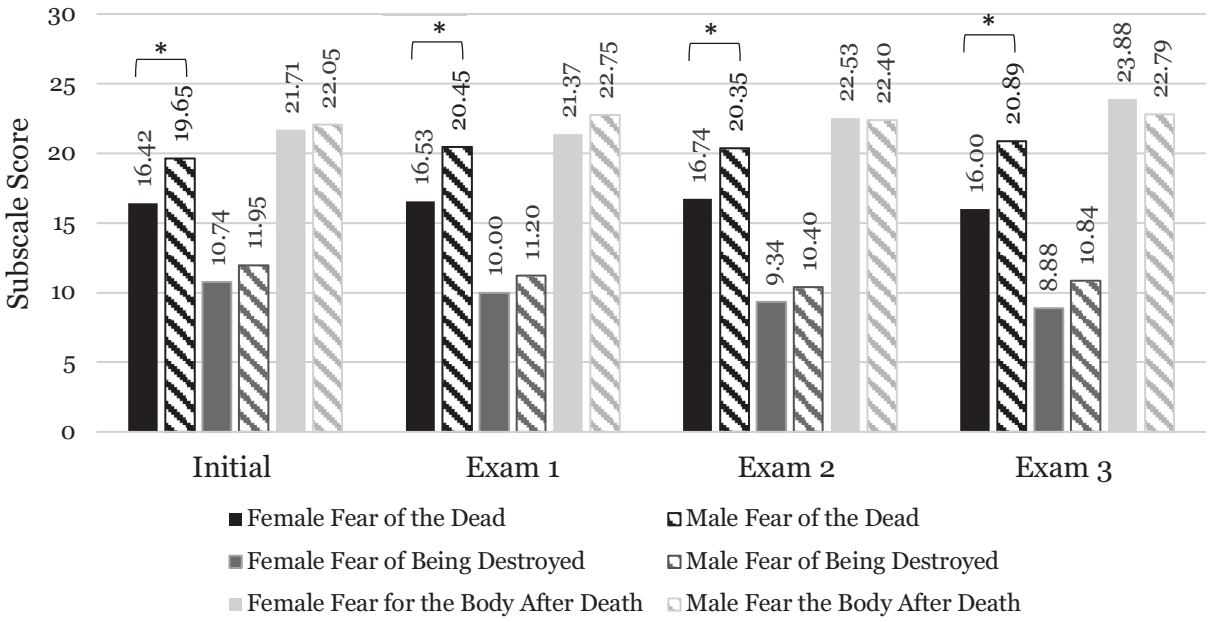

Figure 2. Male and Female Dental Student Fear of Death
Repeated measures ANOVA show no significant changes in males' or females' fear of death in any of the three subscales. *Indicates each time point at which female and male fear of death were significantly different.

Because of the differences in fear of death between genders, male and female specific changes were also assessed. From the initial survey to exam 3, repeated measures ANOVA show no significant changes in females' Fear of the Dead ($F(3,13) = .148$, $p = .929$) or Fear of Being Destroyed ($F(3,13) = 2.237$, $p = .132$). The repeated measures ANOVA model indicated significant changes in females' Fear for the Body After Death over time ($F(3,13) = 3.573$, $p = .044$) but post-hoc comparisons using the Tukey HSD test showed no statistically significant differences between any of the time points. Similar to females, males also showed no significant changes over time in Fear of the Dead ($F(3,16) = .689$, $p = .572$), Fear of Being Destroyed ($F(3,16) = 2.289$, $p = .117$), or Fear for the Body After Death ($F(3,16) = .114$, $p = .950$).

Dental Students - Follow-up Analyses

To further investigate the change in Fear of Being Destroyed, the Friedman Test was used to look for specific changes in each item of this subscale. The Friedman Test is used for a single sample for which a categorical variable is measured over three or more points in time. The Fear of Being Destroyed subscale consisted of four items: 1) I would like to donate my body to science, 2) I do not want medical students using my body for practice after I die, 3) I do not like the thought of being cremated, 4) I do not want to donate my eyes after I die.

There was a statistically significant difference in item 1 ratings across the four surveys, $\chi^2(3) = 12.600$, $p = 0.006$. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.017$. There was a significant difference in item 1 ratings between the initial survey and exam 1 ($Z = -2.729$, $p = 0.006$) but no difference between initial survey and exam 2 ($Z = -2.093$, $p = 0.036$), and initial survey and exam 3 ($Z = -1.919$, $p = 0.055$). This indicates a significant decrease in student's desire to donate their body after death between the initial survey and exam 1 survey.

There was also a statistically significant difference in item 4 ratings across the five surveys, $\chi^2(3) = 13.914$, $p = 0.003$. Using the Wilcoxon signed-rank test and adjusted p value, there was no significant difference between initial survey and exam 1 ($Z = -0.507$, $p = 0.612$) or initial survey and exam 2 ($Z = -2.306$, $p = 0.021$). There was, however, a significant difference between the initial survey and exam 3 ($Z = -2.627$, $p = 0.009$). This indicates a significant decrease in student's desire to donate their eyes after they die. There were no significant differences over time for item 2 ($\chi^2(3) = 6.679$, $p = 0.083$) and item 3 ($\chi^2(3) = 0.731$, $p = 0.866$).

Dental Students - Aim 2

The second aim of the study was to investigate the relationships between fear of death, dissection avoidance behaviors, and course performance. One-way ANOVAs were conducted to compare fear of death between groups of students that reported having different roles in the dissection laboratory. No significant differences were found in Fear of the Dead based on students' role in dissection at exam 1 ($F(2,36) = .620$, $p = .544$), exam 2 ($F(2,35) = 1.048$, $p = .362$), or exam 3 ($F(2,32) = 1.908$, $p = .165$). No significant differences were found in students' Fear of Being Destroyed based on students' role in dissection at the exam 1 survey ($F(2,36) = 1.082$, $p = .350$), exam 2 ($F(2,35) = 1.153$, $p =$

.327), or exam 3 (F (2,32) = 1.374, p = .268). Likewise, there were no significant differences in Fear for the Body After Death at the exam 1 survey (F (2,36) = .154, p = .857), exam 2 (F (2,35) = .462, p = .634), or exam 3 (F (2,32) = .472, p = .628).

Pearson correlations were conducted to determine associations between participation in lab activities, the amount of hours spent in lab outside of scheduled class time, fear of death subscales, and exam performance. There was one outlier on the exam 4 practical exam. This point fell outside three standard deviations and was removed from the data set. Dental students' exam correlations can be found in Table 13.

Table 13. Dental Student Correlations Between Lab Activities, Lab Hours, Fear of Death, and Performance

	% Dissection	% Prosection	% Other	Hours in Lab	Written Exam	Practical Exam
Exam 1						
Fear of the Dead	-.055	.211	-.116	-.024	-.065	.090
Fear of Being Destroyed	.033	.030	-.082	-.050	-.015	.042
Fear for the Body After Death	.011	.048	-.064	-.227	-.124	.104
Exam 2						
Fear of the Dead	.064	.006	-.088	-.108	.166	.159
Fear of Being Destroyed	.238	-.093	-.211	.038	.149	.076
Fear for the Body After Death	.183	.153	-.384*	-.210	.186	.140
Exam 3						
Fear of the Dead	-.105	.182	.052	.171	-.199	-.249
Fear of Being Destroyed	.021	.198	-.086	.195	.071	.241
Fear for the Body After Death	.203	-.178	-.164	.000	-.091	-.093

*Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed

Ordered logistic regressions were conducted to investigate the relationship between avoidance behaviors and fear of death. None of the fear of death subscales significantly predicted avoidance at exam 1. At exam 2, for every one unit increase on the Fear of the Dead subscale, respondents were 1.36 times more likely to score higher on the avoidance of thoughts item. Also at exam 2, for each one unit increase on the Fear for the Body After Death subscale, respondents were .86 times less likely to score higher on avoidance of the cadaver lab, and .83 times less likely to score higher on avoidance of looking at the cadaver. At exam 3, for each one unit increase in Fear of the Dead, respondents were 1.29 times more likely to score higher on avoidance of dissecting and 1.28 times more likely to score higher on avoidance of thoughts about the donors' life. Odds ratio, confidence intervals, and p-values for dental students are reported in Table 14.

Table 14. Odds Ratios of Dental Student Avoidance Behaviors and Fear of Death

	Fear of the Dead Odds ratio (CI), p	Fear of Being Destroyed Odds ratio (CI), p	Fear for the Body After Death Odds ratio (CI), p
Exam 1			
I avoid being in the cadaver lab.	1.19 (1.00, 1.43) p=0.051	1.16 (0.92, 1.48) p=0.196	0.91 (0.80, 1.03) p=0.146
I avoid looking at the cadaver.	1.07 (0.89, 1.29) p=0.457	1.23 (0.96, 1.57) p=0.110	0.96 (0.84, 1.11) p=0.597
I avoid touching the cadaver.	1.16 (0.96, 1.41) p=0.126	1.17 (0.91, 1.52) p=0.226	0.95 (0.83, 1.10) p=0.525
I avoid dissecting the cadaver.	1.17 (0.94, 1.45) p=0.160	1.27 (0.96, 1.45) p=0.093	1.00 (0.87, 1.16) p=0.07
I avoid thoughts about the donor's life.	1.11 (0.94, 1.31) p=0.204	1.19 (0.95, 1.50) p=0.134	0.99 (0.87, 1.12) p=0.864
Exam 2			
I avoid being in the cadaver lab.	1.18 (0.99, 1.40) p=0.069	1.25 (0.98, 1.59) p=0.068	0.86 (0.75, 0.99) p=0.041*
I avoid looking at the cadaver.	1.07 (0.88, 1.30) p=0.506	1.35 (0.99, 1.84) p=.058	0.83 (0.69, 1.00) p=0.044*
I avoid touching the cadaver.	1.25 (0.97, 1.62) p=0.081	1.21 (0.85, 1.71) p=0.289	0.95 (0.80, 1.13) p=0.542
I avoid dissecting the cadaver.	1.26 (1.00, 1.59) p=0.051	1.07 (0.79, 1.46) p=0.642	0.86 (0.71, 1.05) p=0.149

I avoid thoughts about the donor's life.	1.36 (1.11, 1.70) p=0.003*	0.86 (0.69, 1.08) p=0.208	1.01 (0.87, 1.18) p=0.868
Exam 3			
I avoid being in the cadaver lab.	1.19 (0.99, 1.43) p=0.067	1.06 (0.85, 1.33) p=0.616	1.02 (0.88, 1.19) p=0.800
I avoid looking at the cadaver.	1.18 (0.96, 1.45) p=0.111	1.22 (0.95, 1.56) p=0.114	1.06 (0.90, 1.25) p=0.506
I avoid touching the cadaver.	1.20 (0.98, 1.46) p=0.078	1.09 (0.85, 1.40) p=0.491	1.01 (0.87, 1.19) p=0.866
I avoid dissecting the cadaver.	1.29 (1.04, 1.61) p=0.022*	1.12 (0.87, 1.45) p=0.391	0.93 (0.77, 1.12) p=0.403
I avoid thoughts about the donor's life.	1.28 (1.03, 1.60) p=0.028*	1.07 (0.86, 1.33) p=0.546	1.05 (0.89, 1.24) p=0.548

*Indicates a significant predictor of fear of death at the $p < 0.05$ level. CI = 95% confidence interval.

Medical Students - Demographics

One hundred-forty three of the 165 (86.7%) medical students enrolled during the 2019 fall semester completed the initial survey. Of these students, 133 completed the exam 1 survey, 130 completed the exam 2 survey, 127 completed the exam 3 survey, and 128 completed the exam 4 survey. Students were included in all analyses of time points at which they had complete data. See Table 15 for medical student demographic data and Table 16 for medical students' prior anatomy coursework experience.

Table 15. Medical Student Demographic Information

Gender, n (%)	
Male	72 (50.3%)
Female	71 (40.7%)
Age, years	
M ± SD	23.08 ± 1.5
Range	21-31
Admission Variables, M ± SD	
GPA	3.80 ± 0.2
MCAT	503.91 ± 5.0

Table 16. Medical Student Prior Anatomy Coursework

	Students, n (%)
Number of Prior Anatomy Courses	
None	61 (42.7)
One	54 (37.8)
Two	21 (14.7)
Three or more	7 (4.9)
Type of Prior Anatomy Courses*	
Lecture Only	9 (6.3)
Lecture with Models	33 (23.1)
Lecture with Animal Dissection	17 (11.9)
Comparative Anatomy	5 (3.5)
Lecture with Prosection	16 (11.2)
Lecture with Human Dissection	24 (16.8)

*Some students had more than one type of prior anatomy course and others had none, therefore, percentages in Type of Prior Anatomy Courses will not total 100%.

Medical Students - Preliminary Analyses

At each examination the medical gross anatomy students reported the number of hours per week spent in lab outside of scheduled class time. Average hours are reported in Table 17.

Table 17. Average Hours per Week Medical Students Spent in the Cadaver Lab

Exam	Hours, M ± SD (Range)
Exam 1	5.11 ± 3.6 (0 – 20)
Exam 2	5.58 ± 3.6 (0 – 15)
Exam 3	6.43 ± 4.0 (0 – 20)
Exam 4	5.89 ± 4.9 (0 – 25)

At each of the follow-up surveys students were asked to report the percentage of time spent actively dissecting, studying prosections, and participating in activities unrelated to cadavers during scheduled lab time. Average percentages can be found in Table 18.

Table 18. Medical Student Lab Activities

	Time in Lab (%), M ± SD
Exam 1	
Active Dissection	69.62 ± 24.4
Prosection	12.24 ± 8.8
Other	18.06 ± 20.1
Exam 2	
Active Dissection	65.43 ± 25.4
Prosection	12.65 ± 9.1
Other	21.11 ± 22.1
Exam 3	
Active Dissection	63.69 ± 27.0
Prosection	15.67 ± 12.4
Other	20.49 ± 21.2
Exam 4	
Active Dissection	63.41 ± 28.6
Prosection	13.78 ± 11.1
Other	22.73 ± 22.7

Five items were used to collect data concerning medical student avoidance behaviors in laboratory at the conclusion of each block. Frequency counts for these items are presented in Table 19.

Table 19. Medical Student Avoidance Behaviors

	Strongly Agree, n (%)	Mildly Agree, n (%)	Neither Agree or Disagree, n (%)	Mildly Disagree, n (%)	Strongly Disagree, n (%)
Exam 1					
I avoid being in the cadaver lab	9 (6.8)	12 (9.1)	13 (9.8)	25 (18.9)	73 (55.3)
I avoid looking at the cadaver	5 (3.8)	4 (3.0)	8 (6.1)	22 (16.7)	93 (70.5)
I avoid touching the cadaver	7 (5.3)	1 (0.8)	6 (4.5)	17 (12.9)	101 (76.5)
I avoid dissecting the cadaver	5 (3.8)	5 (3.8)	4 (3.1)	17 (12.9)	101 (76.5)
I avoid thoughts about the donor's life	7 (5.3)	24 (18.2)	34 (25.8)	25 (18.9)	42 (31.8)
Exam 2					
I avoid being in the cadaver lab	4 (3.1)	15 (11.5)	14 (10.8)	36 (27.7)	61 (46.9)
I avoid looking at the cadaver	3 (2.3)	10 (7.7)	10 (7.7)	24 (18.5)	83 (63.8)
I avoid touching the cadaver	3 (2.3)	4 (3.1)	9 (7.0)	16 (12.3)	98 (75.4)
I avoid dissecting the cadaver	5 (3.9)	6 (4.7)	6 (4.7)	22 (17.1)	90 (69.8)
I avoid thoughts about the donor's life	6 (4.6)	18 (13.8)	35 (26.9)	32 (24.6)	39 (30.0)
Exam 3					
I avoid being in the cadaver lab	4 (3.1)	21 (16.5)	14 (11.0)	32 (25.2)	56 (44.1)
I avoid looking at the cadaver	3 (2.4)	6 (4.7)	8 (6.3)	24 (18.9)	86 (67.7)
I avoid touching the cadaver	3 (2.4)	5 (3.9)	6 (4.7)	21 (16.5)	92 (72.4)
I avoid dissecting the cadaver	4 (3.1)	8 (6.3)	6 (4.7)	20 (15.7)	89 (70.1)
I avoid thoughts about the donor's life	6 (4.7)	18 (14.2)	35 (27.6)	24 (18.9)	44 (34.6)
Exam 4					
I avoid being in the cadaver lab	9 (7.1)	22 (17.3)	19 (15.0)	28 (22.0)	49 (38.6)
I avoid looking at the cadaver	5 (3.9)	7 (5.5)	8 (6.3)	27 (21.1)	81 (63.3)
I avoid touching the cadaver	4 (3.1)	6 (4.7)	8 (6.3)	23 (18.0)	87 (68.0)
I avoid dissecting the cadaver	4 (3.1)	5 (3.9)	7 (5.5)	32 (25.0)	80 (62.5)
I avoid thoughts about the donor's life	3 (2.3)	17 (13.3)	38 (29.7)	29 (22.7)	41 (32.0)

Medical student fear of death was assessed at each of the four examinations using three subscales from the Multidimensional Fear of Death Scale. The average subscale scores are reported in Table 20.

Table 20. Medical Student Fear of Death

	Fear of the Dead (M ± SD)	Fear of Being Destroyed (M ± SD)	Fear for the Body After Death (M ± SD)
Initial	20.59 ± 4.6	13.78 ± 3.5	23.07 ± 4.9
Exam 1	19.91 ± 5.1	12.33 ± 2.1	22.27 ± 5.4
Exam 2	20.58 ± 4.9	12.94 ± 3.8	23.34 ± 5.3
Exam 3	20.21 ± 4.9	12.54 ± 3.9	22.79 ± 5.1
Exam 4	20.23 ± 5.0	12.53 ± 3.8	22.89 ± 5.0

Exam scores were provided by the medical gross anatomy course director at the end of the course. Written and practical exam averages are presented in Table 21.

Table 21. Medical Student Exam Averages

Exam 1 (M ± SD)		Exam 2 (M ± SD)		Exam 3 (M ± SD)		Exam 4 (M ± SD)	
Written	Practical	Written	Practical	Written	Practical	Written	Practical
81.25 ± 8.2	75.82 ± 12.3	82.12 ± 9.2	75.83 ± 10.9	80.58 ± 9.1	77.33 ± 9.9	86.19 ± 7.6	80.71 ± 11.6

Pearson correlations were conducted to determine the association between the demographic factors of age, GPA, and MCAT and the three fear of death subscales at each time point. For medical students, age was significantly correlated with Fear of Being Destroyed at exam 2 only, with younger students having higher Fear of Being Destroyed. No other significant correlations were found. All correlations for medical students are reported in Table 22.

Table 22. Correlations Between Medical Student Fear of Death and Demographic Variables

	Age	GPA	MCAT
Fear of the Dead			
Initial	.054	-.111	.058
Exam 1	.014	-.078	.086
Exam 2	.055	-.094	-.001
Exam 3	-.015	-.127	.130
Exam 4	-.067	-.098	.096
Fear of Being Destroyed			
Initial	.110	-.029	.086
Exam 1	.090	.016	.004
Exam 2	.187*	-.064	.025
Exam 3	.012	-.062	.055
Exam 4	.098	-.020	.014
Fear for the Body After Death			
Initial	.009	.016	.130
Exam 1	.105	-.111	-.048
Exam 2	.044	-.098	-.068
Exam 3	-.048	-.099	.022
Exam 4	-.018	-.006	-.097

*Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

One-way ANOVAs were conducted to determine if the number of prior anatomy courses was associated with medical student fear of death at the time of the initial survey. Students' number of prior anatomy courses was not significantly associated with initial Fear of the Dead (F (3,139) = .527, p = .664), Fear of Being Destroyed (F (3,139) = .907, p = .439), or Fear for the Body After Death (F (3,139) = .1.171, p = .323). Independent t-tests were also run to compare initial fear of death between students' who had prior exposure to human cadaveric specimens and those who had not. There was no significant difference in Fear of the Dead between those with prior exposure (M = 19.36, SD = 5.5) and those without (M = 20.39, SD = 4.2; t (141) = 1.17, p = .245). Likewise, there was no significant difference in Fear of Being Destroyed between those with prior exposure (M = 12.89, SD = 3.8) and those without (M = 13.79, SD = 3.5; t (141) = 1.32, p

= .190) and no significant difference in initial Fear for the Body After Death between students that had prior exposure (M = 22.78, SD = 4.6) compared to those without prior exposure (M = 22.67, SD = 5.1; t (141) = -.110, p = .912).

Medical Students - Aim 1

In order to address the first aim of the study, repeated measures ANOVAs were conducted to assess how the three fear of death subscale scores changed throughout the course. Medical students showed no significant changes in Fear of the Dead (F (4, 108) = 1.45, p = .222) or Fear for the Body After Death (F (4,108) = 1.83, p = .129). However, a significant change was found in medical students' Fear of Being Destroyed (F (4,108) = 6.86, p < .0005). Post-hoc comparisons using the Tukey HSD test indicated the mean Fear of Being Destroyed was significantly lower at the initial survey compared to all other survey points. The mean subscale scores for each time point can be found in Figure 3.

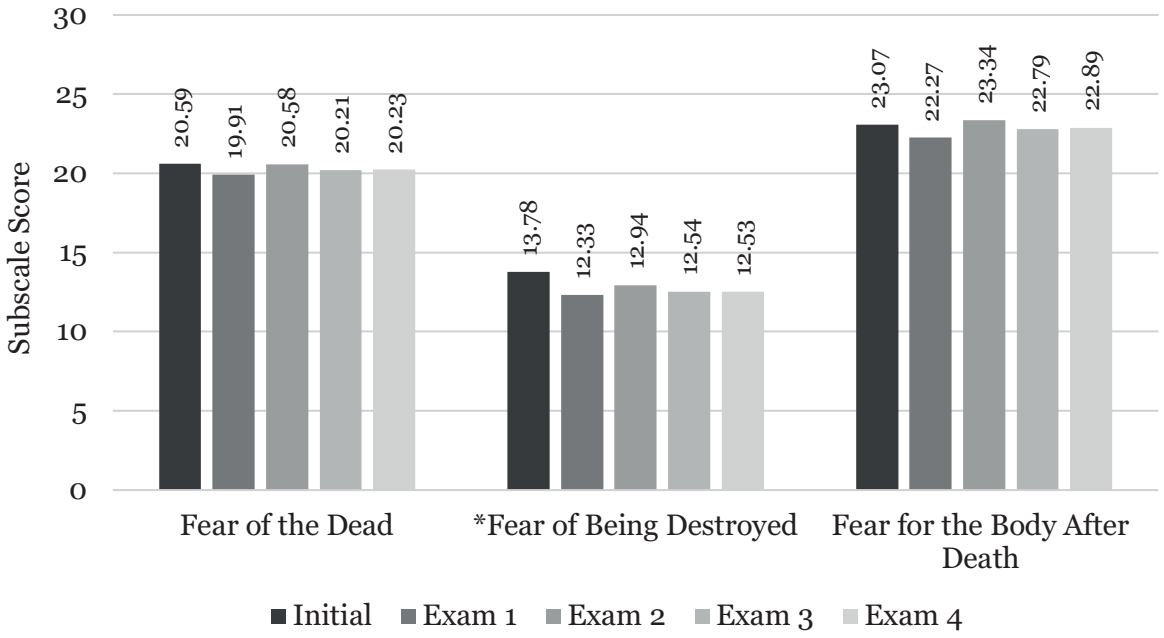

Figure 3. Medical Student Average MFODS Subscale Scores
*Tukeys post hoc test shows significant difference in Fear of Being Destroyed between the initial survey and each of the subsequent exams. (p<.05).

When separated by gender, there were some significant differences between males' and females' fear of death. Independent t-tests show that compared to male medical students, female medical students had significantly higher Fear of the Dead at

the initial survey; $t(141) = 5.95$, $p < .0005$, exam 1 survey; $t(131) = 6.29$, $p < .0005$, exam 2 survey; $t(129) = 4.83$, $p < .0005$, exam 3 survey; $t(125) = 7.74$, $p < .0005$, and exam 4 survey; $t(127) = 5.09$, $p < .0005$. Male medical students also had lower Fear for the Body After Death at exam 1; $t(131) = 3.12$, $p = .002$ and exam 3; $t(125) = 2.24$, $p = .027$. This was not the case for Fear of Being Destroyed as there were no significant differences between males and females on this subscale. Male and female fear of death subscales scores are shown in Figure 4.

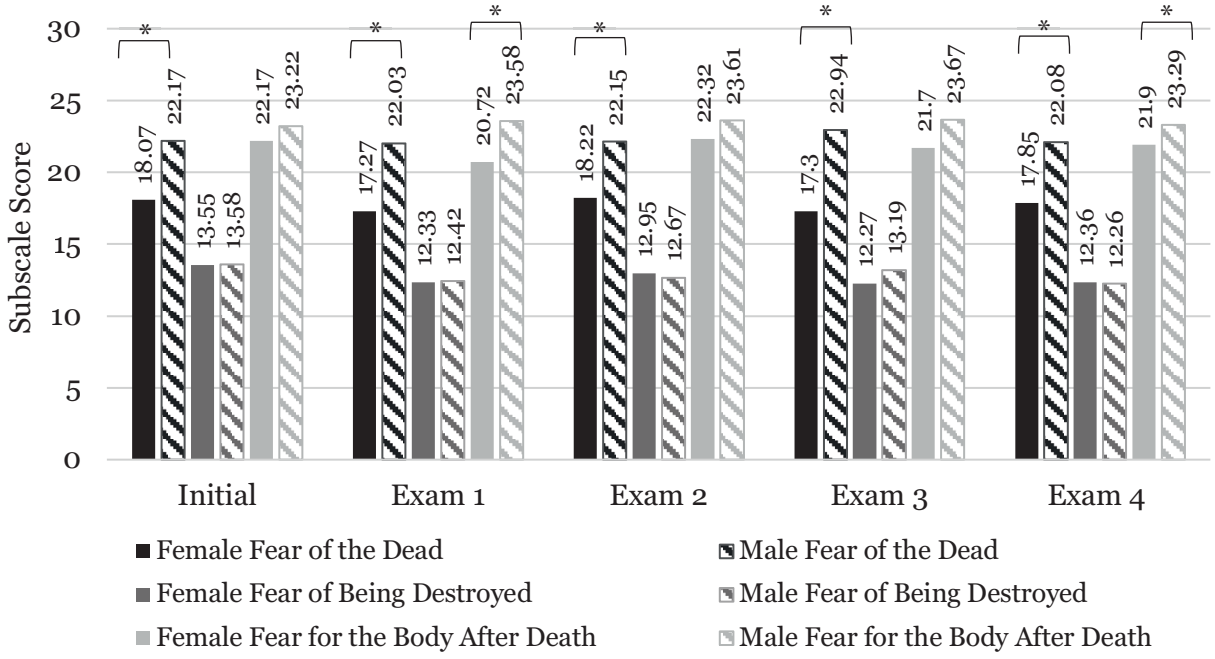

Figure 4. Male and Female Medical Student Fear of Death
Repeated measures ANOVA show no significant changes in male or female fear of death in any of the three subscales. Independent t-tests show that female Fear of the Dead was significantly higher at every time point when compared to males. Female Fear for the Body After Death was also significantly higher than males at exam 1 and exam 4.
*Indicates each time point at which female and male fear of death were significantly different.

Because of the differences in fear of death between gender, male and female specific changes were also assessed. From the initial to exam 4 survey, repeated measures ANOVA show no significant changes in females' Fear for the Body After Death ($F(4,52) = .2.43$, $p = .059$). The repeated measures ANOVA model indicated significant changes in females' Fear of the Dead over time ($F(4,52) = 2.63$, $p = .045$) but post-hoc comparisons using the Tukey HSD test showed no statistically significant differences between time points. There was also a significant difference noted in female medical students' Fear of Being Destroyed ($F(4,52) = 5.93$, $p = .001$). Tukey HSD post hoc

analysis revealed the significant changes were between the initial survey (M = 14.02, SD = 3.7) and exam 1 (M = 12.39, SD = 2.1) as well as the initial survey and exam 3 (M = 12.14, SD = 3.9). Male medical students showed no significant changes over time in Fear of the Dead (F (4,52) = .702, p = .594) or Fear for the Body After Death (F (4,52) = .743, p = .567). However, male medical students were similar to female students in that Fear of Being Destroyed did show significant changes over time (F (4,52) = 3.28, p = .018). Tukey HSD post hoc analysis reveals the significant changes were between the initial survey (M = 13.54, SD = 3.3) and exam 1 (M = 12.27, SD = 2.2) as well as between the initial survey and exam 4 (M = 12.12, SD = 3.9).

Medical Students - Follow-up Analyses

To further investigate the change in Fear of Being Destroyed scores, the Friedman Test was utilized to look at changes in each item of the subscale. The Fear of Being Destroyed subscale consisted of four items: 1) I would like to donate my body to science, 2) I do not want medical students using my body for practice after I die, 3) I do not like the thought of being cremated, 4) I do not want to donate my eyes after I die.

There was a statistically significant difference in item 1 ratings across the five surveys, $\chi^2(4) = 37.011$, $p < 0.001$. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.0125$. There were significant differences between initial survey and exam 1 (Z = -3.973, $p < 0.001$), initial survey and exam 2 (Z = -3.500, $p < 0.001$), initial survey and exam 3 (Z = -4.467, $p < 0.001$), and initial survey and exam 4 (Z = -4.811, $p < 0.001$). This indicates a significant decrease in students' desire to donate their body after death between the initial survey and each of the follow-up surveys.

There was also a statistically significant difference in item 2 ratings across the five surveys, $\chi^2(4) = 35.330$, $p < 0.001$. There were significant differences between initial survey and exam 1 (Z = -2.837, p = 0.005), initial survey and exam 2 (Z = -3.331, p = 0.001), initial survey and exam 3 (Z = -3.877, $p < 0.001$), and initial survey and exam 4 (Z = -4.764, $p < 0.001$). This indicates a significant decrease in student's desire to have medical students using their body for practice after they have died. There were no significant differences over time for item 3 ($\chi^2(4) = 7.940$, p = 0.094) and item 4 ($\chi^2(4)$ = 2.024, p = 0.731).

Medical Students - Aim 2

The second aim of the study was to investigate the relationships between fear of death, dissection avoidance behaviors, and course performance. One-way ANOVAs were conducted to compare fear of death between groups of students that reported having different roles in the dissection laboratory. No significant differences were found in Fear of the Dead based on students' role in dissection at exam 1 (F (2,127) = .640, p = .529), exam 2 (F (2,122) = 1.24, p = .292), exam 3 (F (2,115) = .992, p = .374), or exam 4 (F (3,115) = .840, p = .474). No significant differences were found in students' Fear of Being Destroyed based on students' role in dissection at the exam 1 survey (F (2,127) = .562, p = .571), exam 2 (F (2,122) = .678, p = .509), exam 3 (F (2,115) = 1.11, p = .333), or exam 4 (F (2,115) = .220, p = .883). Likewise, there were no significant differences in Fear for the Body After Death at the exam 1 survey (F (2,127) = .624, p = .538), exam 2 (F (2,122) = .325, p = .723), exam 3 (F (2,115) = .642, p = .538), or exam 4 (F (3,115) = .710, p = .548).

Pearson correlations were conducted to determine associations between participation in lab activities, the amount of hours spent in lab outside of scheduled class time, fear of death subscales, and exam performance. There were one to two outliers on each exam that were removed from the data. Each of these points fell outside three standard deviations. Medical student correlations can be found in Table 23.

Table 23. Medical Student Correlations Between Lab Activities, Lab Hours, Fear of Death, and Performance

	% Dissection	% Prosection	% Other	Hours in Lab	Written Exam	Practical Exam
Exam 1						
Fear of the Dead	-.004	.146	-.061	.155	.048	.080
Fear of Being Destroyed	.036	-.103	.002	.022	.024	.020
Fear for the Body After Death	.104	.093	-.165	.014	.159	.196*
Exam 2						
Fear of the Dead	-.025	.025	-.001	.020	.036	.094
Fear of Being Destroyed	.000	-.078	.043	-.106	.015	.004
Fear for the Body After Death	.068	-.092	-.071	-.007	.110	.160
Exam 3						
Fear of the Dead	-.001	-.064	.029	.026	.077	.127
Fear of Being Destroyed	.086	-.082	-.073	.052	.134	.170
Fear for the Body After Death	.089	-.144	-.015	-.091	.095	.130
Exam 4						
Fear of the Dead	-.140	.277**	.039	.026	.008	-.038
Fear of Being Destroyed	.076	.107	-.148	-.049	.069	.076
Fear for the Body After Death	.106	.039	-.153	-.051	.055	.064

*Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Ordered logistic regressions were conducted to investigate the relationships between medical student avoidance behaviors and fear of death. Fear of the Dead and Fear of Being Destroyed were significant predictors of avoidance behaviors at each exam, with higher fear of death scores predicting higher avoidance. At exam 1 and exam 2 Fear of Being Destroyed was a significant predictor of avoidance, with higher Fear of Being Destroyed predicting lower avoidance. Odds ratio, confidence intervals, and p-values for medical students are reported in Table 24.

Table 24. Odds Ratios of Medical Student Avoidance Behaviors and Fear of Death

	Fear of the Dead Odds ratio (CI), p	Fear of Being Destroyed Odds ratio (CI), p	Fear for the Body After Death Odds ratio (CI), p
Exam 1			
I avoid being in the cadaver lab.	1.14 (1.03, 1.25) p=0.009*	0.92 (0.78, 1.09) p=0.344	1.11 (1.02, 1.20) p=0.016*
I avoid looking at the cadaver.	1.12 (1.01, 1.24) p=0.035*	0.94 (0.77, 1.13) p=0.489	1.11 (1.01, 1.21) p=0.028*
I avoid touching the cadaver.	1.15 (1.03, 1.30) p=0.017*	0.88 (0.72, 1.09) p=0.235	1.16 (1.05, 1.29) p=0.004*
I avoid dissecting the cadaver.	1.12 (1.00, 1.26) p=0.044*	0.76 (0.61, 0.95) p=0.017*	1.17 (1.05, 1.30) p=0.004*
I avoid thoughts about the donor's life.	1.07 (0.99, 1.17) p=0.092	0.99 (0.85, 1.16) p=0.918	1.25 (1.01, 1.17) p=0.031*
Exam 2			
I avoid being in the cadaver lab.	1.15 (1.05, 1.26) p=0.002*	0.99 (0.89, 1.10) p=0.790	1.09 (1.01, 1.18) p=0.037*
I avoid looking at the cadaver.	1.13 (1.02, 1.24) p=0.018*	0.99 (0.87, 1.12) p=0.856	1.18 (1.08, 1.29) p<0.0005*
I avoid touching the cadaver.	1.10 (0.98, 1.23) p=0.090	0.92 (0.79, 1.06) p=0.256	1.21 (1.09, 1.35) p<0.0005*
I avoid dissecting the cadaver.	1.16 (1.04, 1.30) p=0.007*	0.84 (0.73, 0.97) p=0.019*	1.21 (1.09, 1.34) p<0.0005*
I avoid thoughts about the donor's life.	1.12 (1.03, 1.22) p=0.007*	1.04 (0.94, 1.14) p=0.489	1.08 (1.00, 1.16) p=0.055
Exam 3			
I avoid being in the cadaver lab.	1.20 (1.09, 1.33) p<0.0005*	1.06 (0.95, 1.19) p=0.270	1.04 (0.96, 1.14) p=.329

I avoid looking at the cadaver.	1.26 (1.11, 1.42) p<0.0005*	1.05 (0.91, 1.21) p=0.511	1.17 (1.05, 1.31) p=0.005*
I avoid touching the cadaver.	1.26 (1.11, 1.44) p<0.0005*	1.11 (0.95, 1.30) p=0.178	1.14 (1.02, 1.28) p=0.024*
I avoid dissecting the cadaver.	1.19 (1.05, 1.34) p=0.005*	1.02 (0.87, 1.18) p=0.777	1.16 (1.03, 1.30) p=0.012*
I avoid thoughts about the donor's life.	1.06 (0.97, 1.16) p=0.178	1.04 (0.94, 1.15) p=0.469	1.09 (1.00, 1.18) p=0.047*
Exam 4			
I avoid being in the cadaver lab.	1.15 (1.06, 1.24) p=0.001*	1.01 (0.91, 1.11) p=0.869	1.05 (0.97, 1.14) p=0.198
I avoid looking at the cadaver.	1.26 (1.14, 1.40) p<0.0005*	1.04 (0.92, 1.17) p=0.577	1.12 (1.02, 1.24) p=0.019*
I avoid touching the cadaver.	1.23 (1.10, 1.36) p<0.0005*	1.01 (0.90, 1.15) p=0.855	1.18 (1.07, 1.31) p=0.002*
I avoid dissecting the cadaver.	1.22 (1.10, 1.34) p<0.0005*	0.95 (0.84, 1.08) p=0.436	1.11 (1.01, 1.22) p=0.032*
I avoid thoughts about the donor's life.	1.13 (1.05, 1.23) p=0.002*	1.10 (0.99, 1.21) p=0.069	1.07 (0.99, 1.16) p=0.101

*Indicates a significant predictor of fear of death at the p = 0.05 level. CI = 95% confidence interval.

DISCUSSION

This chapter contains summarized findings from aim 1 and 2, along with a discussion of these results and how they relate to current literature. This is followed by conclusions, limitations, and directions for future research. Findings from medical and dental students are discussed separately in each section and are not directly compared. In a prior study, Sundin, Gaines, and Knapp (1980) demonstrated that these two populations have significantly different levels of fear of death, with dental students having higher fear. While this same trend was observed in the current study, analysis of the differences between groups was outside the scope of the study.

Aim 1

The first aim of the study was to describe how gross anatomy students' fear of death changes with continued exposure to cadaveric dissection. The hypothesis was that fear of death would decrease with continued exposure. To address this aim, three subscales from the Multidimensional Fear of Death Scale (MFODS) were used to measure medical and dental students' fear of death at the beginning of the course and at each examination. For dental students, there were no significant changes in Fear of the Dead or Fear for the Body After Death but there was a significant increase in Fear of Being Destroyed from the initial survey to the second examination (Figure 1). Medical students had similar results with no significant changes in Fear of the Dead or Fear for the Body After Death but showed a significant increase in Fear of Being Destroyed between the initial survey and each of the follow-up surveys (Figure 3).

Results from neither group supported the hypothesis which was based on current literature indicating a general decrease in negative symptoms associated with cadaveric dissection upon continued exposure. These studies have used a variety of measures to assess these changes, but to date, none have utilized the MFODS. Using a qualitative approach, Fortunato, Hankin, and Wasserman (2018) described a transformative change in a majority of students where they initially reported high anxiety surrounding cadaveric dissection but became more comfortable as the course continued. Kotzé and Mole (2013) also used a qualitative approach to analyze student responses to open ended questions and reported that student fear and anxiety surrounding dissection dissipated throughout the course. Others have confirmed this trend of decreasing general anxiety using researcher developed questionnaires (Quince, Barclay, Spear, Parker, & Wood, 2011; Snelling, Sahai, & Ellis, 2003; Wisenden et al., 2018) and the validated State Trait Anxiety Inventory tool (Arráez-Aybar, Casado-Morales, & Castaño-Collado, 2004).

Dickinson et al. (1997) looked more specifically at death anxiety using the Death Anxiety Scale and reported changes in both directions. A majority of students (54%) showed a decrease in death anxiety from the beginning to the end of the dissection experience, while 29% showed an increase, and 18% showed no changed. While a majority of students seem to report both decreasing general anxiety and death anxiety, they are unique concepts. General anxiety in a cadaveric dissection course may be influenced by number of factors such as a student's belief in their ability to successfully complete a dissection, achieve their desired grade, or work in harmony with their dissection teammates. Death anxiety, on the other hand, addresses a more specific anxiety or fear that students must face within the cadaver laboratory.

Since death anxiety and fear of death are a specific subset of anxiety related to dissection, anatomy educators should consider the consequences of its specific changes. For example, an increased fear of death has been associated with depression (Thiemann, Quince, Benson, Wood, & Barclay, 2015), lower self-esteem, decreased social support (Cicirelli, 2002), and lower self-efficacy (Fry, 2003). If cadaveric dissection makes students vulnerable to these negative experiences associated with fear of death, some may question if cadaveric dissection is in fact the best way to teach gross anatomy. The increase in Fear of Being Destroyed reported in the current study seems to support the claim made by McLachlan et al. (2004) that perhaps cadaveric dissection may not be an appropriate way to introduce students to sensitive issues surrounding death and dying.

There are a number of alternative methods which could potentially supplement or replace traditional dissection including: ultrasound (Hammoudi et al., 2013; Jurjus et al., 2014), computer assisted learning (Lewis, 2003; Venkatiah, 2010), 3D printing (Lim, Loo, Goldie, Adams, & McMenamin, 2016), and even virtual reality (Codd & Choudhury, 2011). However, if anatomy educators are planning to replace dissection with these modern methods, they should consider the many reported benefits of cadaveric dissection. Dissection exposes students to anatomical variability (Aziz et al., 2002; Cahill, Leonard, Weiglein, & von Lüdinghausen, 2002; Granger, 2004) and pathologies (Cahill et al., 2002; Flack & Nicholson, 2018; Parker, 2002). It is also an opportunity for students to practice aspects of professionalism such as leadership (Pawlina & Lachman, 2004) and teamwork skills (Aziz et al., 2002; Ellis, 2001; Flack & Nicholson, 2018; Granger, 2004; Hussein, Dany, Forbes, Thompson, & Jurjus, 2015; Kotzé & Mole, 2013; Lempp, 2005). Furthermore, when students dissect they gain direct experience working with the tissues of the body (Aziz et al., 2002; Cahill et al., 2002; Flack & Nicholson,

2018; Granger, 2004), an experience that cannot be replaced by any other teaching methodology.

Fear of Death and Demographic Factors

In the current study, female dental students reported significantly higher Fear of the Dead compared to male dental students (See Figure 2). This gender difference has been demonstrated before among college students using the Death Anxiety Scale (Pierce Jr, Cohen, Chambers, & Meade, 2007) and within the general population using the MFODS (Cicirelli, 2001; Missler et al., 2012; Tang, Wu, & W. Yan, 2002; Zana, Szabó, & Hegedűs, 2009). Age and undergraduate GPA also influenced dental students' fear of death, particularly Fear of the Dead and Fear of Being Destroyed. Older students reported a lower fear of death on these two subscales. These findings are consistent with prior studies examining death anxiety in the general population (Cicirelli, 2001; Zana et al., 2009) as well as in college-aged students (Chen, Del Ben, Fortson, & Lewis, 2006; Nienaber & Goedereis, 2015; Tang et al., 2002). A higher undergraduate GPA was associated with higher Fear of the Dead and Fear of Being Destroyed. This could be explained by the fact that fear of death is associated with certain personality traits, such as neuroticism (Howells & Field, 1982) and these traits may ultimately influence both fear of death and how students perform academically. When prior experiences were considered, there was no association between the number of prior anatomy courses and initial fear of death. Only Fear for the Body After Death was associated with prior exposure to cadaveric materials, with dental students that had prior exposure having higher initial fear.

For medical students, there was also a significant difference in fear of death between males and females, with females having higher Fear of the Dead at each time point and higher Fear for the Body After Death at exam 1 and exam 4. These findings are also consistent with literature demonstrating higher fear of death in females (Cicirelli, 2001; Missler et al., 2012; Tang, Wu, & W. Yan, 2002; Zana, Szabó, & Hegedűs, 2009). This difference has even been reported among medical students when using the MFODS (Dickinson et al., 1997; Howells & Field, 1982; Quince et al., 2011). Significant associations between age, undergraduate GPA, and fear of death were not found within the medical student population. The lack of association between fear of death and age is in contrast to results from prior studies, however, none of these had specifically considered students at the professional school level (Chen, Del Ben, Fortson, & Lewis,

2006; Cicirelli, 2001; Nienaber & Goedereis, 2015; Tang et al., 2002; Zana et al., 2009). Medical students are a unique group and are likely aware of the expectation that they will perform dissections in medical school. They may also have expectations concerning their future involvement with death and dying as a physician and may begin medical school having already accepted that death will likely be a part of their career. This mindset about death and dying among medical students may offset any other differences in fear of death that existed between students of different ages or with varying undergraduate GPAs.

Anatomy instructors should be aware that specific demographic factors, such as gender, may influence students' fear of death and ultimately their experience in the dissection laboratory. It may be helpful to inform students at the beginning of a gross anatomy course about which factors are associated with higher fear of death so that students might be able to identify themselves as being at risk of experiencing higher levels of fear. If students are aware of their own vulnerability they may be able to seek out resources early on in a dissection course that will help them manage their fears and ultimately lead to an improved experience in the laboratory.

Changes in the Fear of Being Destroyed

Both dental and medical students showed an increased Fear of Being Destroyed after beginning dissection. To further investigate this change, each item in this subscale was analyzed to detect specific changes over the course. The four items in the Fear of Being Destroyed subscale were: 1) I would like to donate my body to science; 2) I do not want medical students using my body for practice after I die; 3) I do not like the thought of being cremated; and 4) I do not want to donate my eyes after I die. For dental students, there was a significant change in items 1 and item 4 after beginning dissection. Students reported lower agreement with wanting to donate their body to science or donate their eyes after they die. The medical student data showed a significant change in items 1 and 2, with students reporting lower agreement with wanting to donate their body to science or wanting medical students to use their body for practice after they die.

This indicates that the dissection experience decreased students' willingness to donate. It may be that certain dissection tasks are more gruesome than students had originally anticipated. For example, students performing dissections in these courses are responsible for hemisecting the pelvis, which involves using a scalpel to cut through the reproductive organs, sawing through the bony pelvis, and then carrying lower limbs to

the laboratory sink to clean out any waste. Students also dissected the orbit, disarticulated the head from the vertebral column, and bisected the head in the mid-sagittal plane. While these difficult dissections provide a unique opportunity to visualize structures students would not otherwise be able to see, they also force students to confront the humanity of their donors by necessitating that students disassemble some of the most human parts of the cadaver. After witnessing these dissections, students may be hesitant to subject themselves to the same treatment.

Cahill and Ettarh (2008) also described this trend of medical students' decreased willingness to donate after a nine week dissection course. Originally 31.5% of students were in favor of donating their bodies to medical science, while 23.4% were opposed. At the end of the course, students that were in favor of donating had decreased to 19.6% and students opposed had increased to 40.2%. They also reported that fewer students were in favor of the idea of their family members donating their body to science. This decreased motivation to donate may become an issue for clinical education programs as dissection remains the most popular way to teach anatomy (Estai & Bunt, 2016) and the demand for donors remains high (Cornwall & Stringer, 2009).

Aim 2

The second aim of the study was to describe the relationship between students' fear of death, cadaveric dissection avoidance behaviors, and gross anatomy performance. We hypothesized higher fear of death would be positively correlated with dissection avoidance behavior and lower performance. To address this aim, students' fear of death was assessed multiple times over the course of the semester using three subscales from the MFODS and a questionnaire collecting dissection avoidance behavior data. To assess avoidance behaviors, students were asked how they spent their time during scheduled laboratory hours, their role in dissection, and how much time they spent in laboratory outside of scheduled hours. They were also asked to report the extent to which they agreed or disagreed with five statements concerning avoidance in the dissection laboratory. Relationships between these variables were then analyzed along with written and practical examination scores.

Fear of Death and Dissection Avoidance Behaviors

Among dental students, there were no significant correlations between any of the fear of death subscales and the activities students participated in during dissection

laboratory (dissection, prosection, other) or the number of hours they spent in laboratory outside of scheduled hours. There were no significant differences in fear of death based on students' role in dissection, however, a majority of students (63 – 77%) consistently reported that dissection was split evenly between all group members. The small amount of variability in these responses may contribute to lack of association between these two variables.

When considering specific avoidance behaviors of dental students, higher Fear of the Dead was associated with higher levels of avoidance of dissection and thoughts about the donors' life at examination 2 and 3 (See Table 14), which was consistent with the initial hypothesis. In contrast to this, higher Fear for the Body After Death was associated with less avoidance of the cadaver lab and looking at the cadaver. Fear for the Body After Death is different from the other subscales in the fact that all items specifically relate to the participant's fears about the fate of their own body after their own death. The other subscales deal more with a participant's encounters with death and their ideas about donation after death. It is possible that students with higher Fear for the Body After Death are less inclined to avoid the cadaver lab and looking at the cadaver because they are concerned by fear about their own body which in turn, urges them to explore the cadaver lab and the cadavers.

When considering dental student ratings of agreement with avoidance behavior statements, throughout the entire course only 21 – 34% of dental students strongly disagreed that they avoided the cadaver lab and 18 – 31% strongly disagreed that they avoided thoughts of the donor's life. Meanwhile, 54 – 74% of dental students strongly disagreed that they avoided looking at, touching, or dissecting the cadaver, a substantially higher percentage than those who had strongly disagreed with the statements concerning the laboratory and thoughts of the donors life.

Among medical students there were no significant correlations between fear of death and activities students participated in during dissection laboratory, except at examination 4 where higher Fear of the Dead was associated with less time using prosections. During the fourth block medical students are studying the head and neck regions. The prosections that students used for this block are primarily severed heads which were stored in a fluid-filled tank. It may be that during this block, using the prosections may actually be more difficult for students with higher fear of death compared to studying this region on a full cadaver.

There were no correlations between any of the fear of death subscales and the number of hours medical students spent in laboratory outside of scheduled hours. There were also no significant differences in fear of death based on the student role in dissection. However, like the dental students, a majority of medical students (78 – 92%) consistently reported that dissection was split evenly between all group members and this homogeneity may contribute to the lack of association.

For medical students, Fear of the Dead and Fear for the Body After Death were both associated with most of the avoidance behaviors at all of the examinations, which confirms the initial hypothesis. However, higher Fear of Being Destroyed was associated with less avoidance of cadaveric dissection. This could have been the case because the students who are most heavily involved with dissection may be less likely to want to donate as they are most involved with disassembling the cadaver and have a more personal experience with the gruesome process of dissection. A decrease in the desire to donate would be reflected in higher Fear of Being Destroyed, as this subscale addresses this issue in several ways. Also similar to dental students, throughout the entire course only 39 – 55% of medical students strongly disagreed that they avoided the cadaver lab and 30 – 37% strongly disagreed that they avoided thoughts of the donor's life. Meanwhile, 63 – 76% of strongly disagreed that they avoided looking, touching or dissecting the cadaver.

For both dental and medical students, fewer students strongly disagreed that they avoided thoughts about the donor's life. Avoiding thoughts of the donor's life has been reported as a coping mechanism for students in the dissection lab (Francis & Lewis, 2001; Kotzé & Mole, 2013; Tseng & Lin, 2016). Others have reported that students intentionally focus on the task at hand in order to cope with the process of dissection (Getachew, 2014; Mc Garvey, Farrell, Conroy, Kandiah, & Monkhouse, 2001). This purposeful shifting of attention to the task at hand also suggests a denial of the cadaver's personhood which is similar to avoiding thoughts about the donor's life. Results from the current study show similar trends with students being more likely to engage in looking at, touching, and dissecting the cadaver by dehumanizing the process. Students may be focusing on the mechanical task of dissection while avoiding the reality of the donor having once been alive, ultimately denying the personhood of the donor to cope with the difficult task. More avoidance of the cadaver lab could be due to a number of factors and may not be directly related fears in the anatomy laboratory. For example, students may have avoided the cadaver lab because they needed to dedicate more time to other classes.

Fear of Death and Performance

Prior to the current study, the relationship between fear of death and performance had yet to be analyzed in a gross anatomy course. For dental students there were no significant correlations between fear of death and examination performance at any of the time points. These results do not support our initial hypothesis that higher fear of death was associated with lower scores. It is possible that students with higher levels of fear of death are able to structure their experience in a way that their fears do not hinder their learning or their exam performance. Perhaps these students quickly established coping mechanisms to ensure they could still be successful in the gross anatomy course.

For medical students, lower Fear for the Body After Death was associated with higher practical scores at examination 1 only. These findings somewhat support the initial hypothesis. In this case, perhaps the medical students with higher fears were preoccupied by their fears during the examination and this hindered their ability to focus. Another possibility is that their fears detracted from their learning during laboratory session and this resulted in decreased examination scores. More research is needed to understand this relationship between fear of death and practical exam performance and why these two variables may be related.

When considering both cohorts together, the only correlation found between fear of death and performance was related to performance specifically on the practical examination. This may be due to the fact that students must confront the cadavers during the practical examinations, while this is not the case for the written examination which takes place in an entirely separate location. Overall, there was only one point of significant correlation between fear of death and performance and the results do not suggest a definitive relationship between the two variables. It is possible that students in health professions such as medicine or dentistry begin gross anatomy having already considered death and dying and were aware that cadaveric dissection would be a part of their education. Early awareness of this requirement may help students to cope with varying levels of fear of death and focus on learning the anatomical content necessary to continue in their program.

Conclusions

Results from the dental and medical students revealed no significant changes in Fear of the Dead or Fear for the Body After Death during the gross anatomy course.

There was, however, an increase in Fear of Being Destroyed for both cohorts. This change seems to be primarily related to a decrease in students' desire to donate their bodies after death.

Fear of death was associated with some avoidance behaviors, particularly for the medical students, but there was very little correlation between fear of death and performance. It appears that students who have a higher fear of death may use avoidance to cope with dissection, but ultimately the higher fear of death does not seem to negatively impact their examination performance. Based on these findings, instructors may want to allow students the autonomy to decide how much interaction they would like to have with the cadavers. This may mean that dissection laboratories which have implemented rotating team roles (i.e., team leader, dissector, dissector guide), may need to reconsider this practice as it forces students to interact with the cadaver is specific ways that do not support potential coping mechanisms.

There may be instructors who feel the benefits of dissection are too great to allow students the option of decreasing their direct interaction with the process of dissection in order to cope with an increased fear of death. In this case, it is the responsibility of the instructor to provide resources that can help students manage their fears. There have been several studies that have implemented death education courses and found that after the course, students had significantly lower fear of death (McClatchey, 2015; Wong, 2009). McClatchey and King (2015) created a Death, Dying, and Bereavement course for human services students. Students enrolled in the course discussed death and dying from religious and legal perspectives, the dying process, biomedical issues such as euthanasia, and the grieving process. It also included a visit to a funeral home, texts related to death and dying, and a number of personal reflection papers. When controlling for initial fear of death score, McClathcey and King (2015) found that students who had taken the course had a significantly lower overall fear of death compared to students who had not taken the course. Mooney (2005) created a 13 week course for undergraduate nursing students which focused on helping students explore their attitudes about death and dying through discussion with their peers. In this study the Collett-Lester Fear of Death Scale showed that fear of death did in fact decrease after the course. In addition to formal classes, instructors should make students aware that people have a multitude of different reactions to dissections, both positive and negative, and that discussion with a counselor or peers may help them better understand their feelings and fears about the very unique experience of dissection.

Limitations

While the current study has addressed important gaps in the literature, it is not without limitations. First of all, only three of the eight subscales from the MFODS were used to measure students' fear of death. It was not feasible to use the entire 42 question scale as students were asked to complete the survey several times and an extensive survey may have discouraged them from participating. The three subscales chosen were the most closely related to students' experience in a dissection laboratory. It is common for individual subscales to be reported when using the MFODS, however, a total fear of death score is usually reported as well. Our results lack the total score and therefore may be difficult to compare to prior literature. It is also possible that using the entire scale could have revealed other associations between fear of death, dissection avoidance behaviors, and performance or that a subscale that was not used actually plays a larger role in students dissection experience.

The second limitation is concerned with the self-report aspects of the surveys. Students may have had trouble accurately reporting their level of involvement in dissection activities for a variety of reasons. First of all, the options provided for the item inquiring about students' role in dissection were rigid and gave no opportunity for students to offer any further insights. For this reason, the majority of students may have chosen that dissection was split evenly between group members because it was the closest description to a nuanced and more complex dynamic between the group members and their daily contribution. Additionally, students may have struggled to accurately recall and average their time spent dissecting, studying prosections, or participating in non-cadaver related activities. This may have also been the case for the number of hours students spent in the laboratory outside of scheduled hours and students may have over or under reported their attendance simply because they were asked to recall their behavior from the past three to five weeks.

Finally, a few of the measures of avoidance behavior were somewhat vague and may have been influenced by a number of factors besides fear of death. For example, both the number of hours spent in lab outside of regular class hours and the level of avoidance of the cadaver may have been heavily influenced by students' other commitments, including their other courses.

Future Directions

This study has provided a number of avenues for future research, a few of which stem from the limitations while others build upon the presented results. As discussed in the limitations, student activities in lab and average hours spent in lab were self-reported by the students. In order to collect more accurate data, future studies might consider asking students to report activities at the conclusion of each laboratory and record time in lab using a sign in sheet. Another possibility would be to consider observing students to document objective data about their time, participation, and avoidance behaviors in the lab. Objective data could also be collected with physiological stress measures when students are in lab. However, these measures would not point to specific emotions or attitudes such as fear of death.

Future studies may also examine fear of death among students using a measure that could differentiate between state and trait fear of death. It is possible that the current MFODS is measuring a respondent's general fear of death which is specific to their character. If so, it may not be sensitive to specific changes in fear of death from day to day. The MFODS items could be modified to assess students' attitudes in the moment, rather than their general attitudes, in order to detect specific changes that occur during a cadaveric dissection course.

A major question that arose from this study concerns students' decreased desire to donate after exposure to dissection. Future studies may explore if there are specific experiences that make students less likely to donate and if so, perhaps consider restructuring these parts of the laboratory. Also, interviewing students whose desire to donate does not decrease may reveal coping mechanisms that could be shared with other students to enhance their experience, and ultimately maintain better attitudes toward body donation. It may also be interesting to see if the decrease in willingness to donate would persist if only prosections were used. This way, students would not be expected to complete the emotionally difficult dissections such as the face, hands, and genitals (Finkelstein & Mathers, 1990; Moxham, Plaisant, Lignier, & Morgan, 2019; Snelling et al., 2003) and would perhaps be shielded from the particularly gruesome aspects of the cadaver lab. Along these same lines, future studies may consider if willingness to donate returns to baseline levels over time. After students have been away from the cadaver lab for a period of time, their memories of dissection may fade, allowing them to reconsider donation.

Another point of interest arising from the study is the demographic factors that are associated with fear of death. Since two of the three MFODS subscales did not change over time, the fear of death that students begin the course with may be the more important thing to consider. Future studies might consider exploring how prior personal experiences such as the death of a loved one, death of animals, past military service, religion, or the study of death and dying are related to students' fear of death. If these demographic factors are identified, they could be shared with students upon entry into the gross anatomy course. Then students can be made aware of the factors that may make them more vulnerable to experiencing higher fear of death and can take steps to seek out support resources.

Lastly, the current study found little support for a relationship between fear of death and performance. Future studies should investigate other variables that may be related to fear of death. For example, medical students' fear of death could potentially influence students' choice of specialty, as certain specialties are more or less likely to encounter death. It has also been reported that nurses' fear of death is associated with attitudes toward terminally ill patients (Peters et al., 2013) and it may be interesting to see if this trend persists in other healthcare professions. In student populations, it would be helpful to gain a better understanding of how fear of death correlates to measures of well-being in order to find new ways to support our students.

SUMMARY

While some anatomists believe gross anatomy is an important opportunity for students in health professional programs to explore and develop their ideas and attitudes toward death and dying, others argue that it may not be an appropriate way to introduce students to these complex and deeply personal issues. A multitude of negative reactions have been reported in response to dissection, but there is still very little known about how dissection impacts students' ideas about death and dying, specifically how it affects students' fear of death. The current study aimed to investigate the relationship between fear of death, dissection avoidance behaviors, and examination performance throughout two gross anatomy courses that used cadaveric dissection.

To accomplish this, medical and dental gross anatomy students were surveyed before their first dissection and again after each examination block. The initial survey collected demographic data along with fear of death data using three subscales from the Multidimensional Fear of Death Scale. Follow-up surveys assessed students dissection avoidance behaviors and fear of death. Performance data was collected from the course directors at the conclusion of each course. The major findings from the current study are as follows:

- For both groups, there were no significant changes in Fear of the Dead or Fear for the Body After Death, but there was a significant increase in Fear of Being Destroyed.
- The increase in Fear of Being Destroyed was primarily due to a decrease in students' willingness to donate their body after death.
- Certain demographics were associated with higher fear of death. Females in both groups had significantly higher Fear of the Dead. For the dental students only, age and undergraduate GPA were significantly associated with students fear of death at the initial survey.
- Fear of the Dead and Fear for the Body After Death were associated with avoidance behaviors, particularly for the medical students.
- There was only one point of significant correlation between the fear of death subscales and exam performance, ultimately suggesting a weak relationship between fear of death and performance.

Based on these findings, instructors may want to consider which specific dissections are detracting from students desire to donate their body after having

participated in the dissection and consider alternative ways to approach these regions. Furthermore, because fear of death did not consistently correlate with performance, anatomy instructors may want to consider allowing students the autonomy to decide how much and in what ways they engage in the dissection process and find ways to offer support to students that struggle with higher fear of death.

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APPENDIX

Appendix A
Initial Survey

1. Student Name: _____

2. Program of Study (circle one): Medicine Dentistry

3. Age: _____

4. Gender (circle one):

   Male Female Transgender Male Transgender Female

5. Undergraduate cumulative GPA: _____

6. Please provide the appropriate score based on your program of study:

   MCAT score: _____ DAT score: _____

7. How many prior anatomy courses have you taken at the college level? (circle one) Examples include: anatomy, anatomy and physiology, comparative anatomy, gross anatomy laboratory, etc.

   None One Two Three or more

8. If you have taken a prior anatomy course, please indicate the type of course (select all that apply).

   - Lecture only
   - Lecture and Laboratory with models (no dissection)
   - Lecture and Laboratory with animal dissection
   - Comparative anatomy
   - Lecture and Laboratory with prosected human cadavers
   - Lecture and Laboratory with human cadaveric dissection

INSTRUCTIONS: Listed below are death-related events and circumstances that some people find to be fear-evoking. Indicated the extent to which you agree or disagree with each statement by circling one number for each item. Do not skip any items if you can avoid it.

1=Strongly agree
2=Mildly agree
3=Neither agree nor disagree
4=Mildly disagree
5=Strongly disagree

1	2	3	4	5	I dread visiting a funeral home.
1	2	3	4	5	I would like to donate my body to science.
1	2	3	4	5	I am afraid of my body being disfigured when I die.
1	2	3	4	5	I dread the thought of my body being embalmed someday.
1	2	3	4	5	Touching a corpse would not bother me.
1	2	3	4	5	I do not want medical students using my body for practice after I die.
1	2	3	4	5	The thought of my body being found after I die scares me.
1	2	3	4	5	Discovering a dead body would be a horrifying experience.
1	2	3	4	5	I do not like the thought of being cremated.
1	2	3	4	5	I would be afraid to walk through a graveyard, alone, at night.
1	2	3	4	5	It doesn't matter whether I am buried in a wooden box or a steel vault.
1	2	3	4	5	It would bother me to remove a dead animal the road.
1	2	3	4	5	I do not want to donate my eyes after I die.
1	2	3	4	5	The thought of being locked in a coffin after I die scares me.
1	2	3	4	5	I am afraid of things which have died.
1	2	3	4	5	The thought of my body decaying after I die scares me.

Appendix B
Follow-up Survey

INSTRUCTIONS: Please answer all questions in relation to this exam block.

1. Student Name: _____

2. During this exam block, which of the following best describes your role in dissection? (circle one)

   - I do the majority of dissection
   - Dissection is split evenly between group members
   - I rarely assist with dissection
   - I never participate in dissection

3. What percentage of scheduled lab time did you typically spend doing each of these activities? (all activities combined should total 100%)

   Active dissection _____%
   Study of pre-dissected materials (prosections) _____%
   Activities unrelated to cadavers (reading, using models, general study) _____%

4. On average, how many **hours per week** did you spend in the cadaver lab OUTSIDE of scheduled lab time? _____

5. Indicate the extent to which you agree or disagree with each of the following statements.

   1=Strongly agree
   2=Mildly agree
   3=Neither agree nor disagree
   4=Mildly disagree
   5=Strongly disagree

1	2	3	4	5	I avoid being in the cadaver lab.
1	2	3	4	5	I avoid looking at the cadaver.
1	2	3	4	5	I avoid touching the cadaver.
1	2	3	4	5	I avoid dissecting the cadaver.
1	2	3	4	5	I avoid thoughts about the donor's life.

INSTRUCTIONS: Listed below are death-related events and circumstances that some people find to be fear-evoking. Indicated the extent to which you agree or disagree with each statement by circling one number for each item. Do not skip any items if you can avoid it.

1=Strongly agree
2=Mildly agree
3=Neither agree nor disagree
4=Mildly disagree
5=Strongly disagree

1	2	3	4	5	I dread visiting a funeral home.
1	2	3	4	5	I would like to donate my body to science.
1	2	3	4	5	I am afraid of my body being disfigured when I die.
1	2	3	4	5	I dread the thought of my body being embalmed someday.
1	2	3	4	5	Touching a corpse would not bother me.
1	2	3	4	5	I do not want medical students using my body for practice after I die.
1	2	3	4	5	The thought of my body being found after I die scares me.
1	2	3	4	5	Discovering a dead body would be a horrifying experience.
1	2	3	4	5	I do not like the thought of being cremated.
1	2	3	4	5	I would be afraid to walk through a graveyard, alone, at night.
1	2	3	4	5	It doesn't matter whether I am buried in a wooden box or a steel vault.
1	2	3	4	5	It would bother me to remove a dead animal from the road.
1	2	3	4	5	I do not want to donate my eyes after I die.
1	2	3	4	5	The thought of being locked in a coffin after I die scares me.
1	2	3	4	5	I am afraid of things which have died.
1	2	3	4	5	The thought of my body decaying after I die scares me.