Drew University
College of Liberal Arts

FASHION AND DISEASE: AN ANALYSIS OF THE EFFECTS OF TUBERCULOSIS IN A SOCIAL CONTEXT ON THE PHYSICAL REMAINS OF A 19TH CENTURY CEMETERY IN PHILADELPHIA

A Thesis in Anthropology

by

Juliet LaVigne

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Abstract:

This thesis analyzes the romanticization of tuberculosis in 19th century literature and art. American and European literature are compared to see the prevalence of the romantic ideal of tuberculosis. This framework is then used to contextualize the data collected from the osteological methodology. For this project, ten individuals from an archaeological site at a cemetery in Philadelphia were analyzed to see if there was any evidence of long-term corset usage. The cemetery was active from the 1700s until 1860, when it was closed and relocated, which is when the romanticization of tuberculosis appears in literature and art. This romanticization changed the ideal form of beauty at the time to one that looked like a tubercular person, known today as consumptive chic. By analyzing the data collected from the ribs of the archaeological remains and comparing them to a modern medical set, it can reveal if there is any statistically significant difference between the ribs of the archaeological individuals and the modern individual. This was determined by using PERMANOVA tests in RStudio. These results were then contextualized using the analysis presented in the literature review. Historical and cultural context is also given to better understand the results and possible directions that should be taken for future research.

Chapter 1: Introduction

Tuberculosis is a disease that has impacted humanity since prehistory (Dormandy, 2000). Throughout this time, it has evolved, just like human societies, and so has the way humans interact with it. During the 19th century, tuberculosis took on a mysterious and romantic air as a way to cope with the loss of many children and youths to the disease. This romantic ideal of the disease was portrayed in European literature and art with the Romantic poets pioneering this idea, and the Pre-Raphaelite brotherhood reenforcing it with their paintings of tubercular women. Tuberculosis became synonymous with beauty and artistic genius which is why fashion tried to imitate it (Dormandy, 2000). The corset adopted a more hour-glass-like shape to accentuate the small waist of the wearer and some people took to rigid diets and ingesting lemon juice tonics to suppress their appetite and create the skeletal-like appearance of someone who was tubercular (Seleshanko, 2012; Dormandy, 2000). With this fashion trend, tight lacing became popular among the upper classes to decrease waist size even more. This could lead to medical complications especially paired with arsenic make-up and fasting diets (Whorton, 2010). These extreme fashion trends were usually limited to the upper classes as not all women could afford to be sickly and wear extremely constricting corsets. Even so, this idea of beauty had a lasting impact as today many people still correlate corsetry with tight lacing and body shaping (Gibson, 2020).

This research project aims to look at the historical and literary context in which to frame the romanticization of tuberculosis. Since there was a lack of literature that romanticized tuberculosis in America, fashion was used as a proxy. The skeletal remains were examined in the framework of how the fashion of the time impacted the morphology of the ribs and thoracic vertebrae. This connection between the literature, fashion, and the body is what is further explored in this project. This project then analyzes archaeological human skeletons in order to determine if the corsetry trends found by Gibson (2015) in European individuals can also be found in the United States. This thesis begins with a literature review which will be returned to in the discussion to frame the results from the osteological data and analysis in the contemporary ideas and practices. Following that is a description of the materials and methods that were used for the skeletal study, the results, and the discussion itself.

Chapter 2: Literature Review

This chapter synthesizes current literature on the Romantic and Gothic movements in Europe and America. It discusses the historical context and framework in which the data for this project will be analyzed in the Discussion chapter. First, the chapter will discuss everyday life in Philadelphia as well as the fashion trends during the 19th century. Following this, the chapter will synthesize Gothic and Romantic art and literature that impacted the ideal of beauty in the 19th century. It is important to keep in mind the differences between American and European literature and their prevalence during the 19th century when analyzing the literature. The plethora of examples in European literature contrast strongly with the few in American literature.

2.1 Life in the 19th century

The 1800s saw many political, fashion, and literary changes in both America and in Europe with the Romantic and Gothic art movements and the Progressivism political movement (Nugent, 2010). While this research will touch on the changes, specifically literary, that occurred in Europe, it is only for comparison or to show the connection between Europe and America. The main focus of this research is Philadelphia, which was an urban center in the 1800s, as it is now. This area, like many urban cities on the east coast, had a high immigrant population (Hershberg, 1981; Nugent, 2010). With an increase in the population and a location along a river, it made sense to industrialize. During and following the American Revolutionary War, Philadelphia became a major import-export distributer of European goods (Hershberg, 1981). This transitioned to a more industrialized center as Philadelphian manufacturers grew, providing a mix of artisanal and manufactured goods for the residents of the city (Hershberg, 1981). With the increase of manufactured goods, more commodities became more accessible, especially with second-hand shops (Nugent, 200; Gibson, 2020).

The changes within the city also impacted food production and diet. More processed foods started becoming available, as well as more caloric foods (Veit et al., 2017). This trend only really affected the upper and middle classes, leaving the poor to struggle to find nutritious food (Veit et al., 2017). Along with the increase in manufacturing industrialization was also agricultural industrialization which allowed for more productive agricultural practices (Veit et al., 2017). For the middle class,

this meant an increase in the food available to them and specifically an increase in starches in the daily diet (Veit et al., 2017).

2.2 Fashion

The corset was a vital component in a woman's wardrobe for over 200 years (Gibson, 2020). It was a supportive undergarment that women of all social statuses had. Over the course of its history, the corset has changed to fit the needs of the women who wore it as well as the ever-shifting styles and economic statuses. Corsets were typically handmade, and they were frequently passed down or sold in second-hand shops, which kept them affordable for women of all classes (Gibson, 2020). They could be made with fabrics as expensive as silk or as cheap as cotton or linen. The inside of the corsets varied as much as the outer material with some having wood paneling and others utilizing whaleboning, which was made from the baleen of a whale, or steel boning (Gibson, 2020). The use of a hard object inside the corset lining was to give support. The different types of boning or paneling were mainly for aesthetic or status symbols rather than for practical purposes. Corset styles varied as much as the women who wore them. Some were built into pockets in dresses while others could be used as an undergarment underneath the outfit, like Figure 1. Others still were worn over chemises as a statement piece, like the pointed under-bust corsets as depicted in Figure 2 (Gibson, 2016). While there was some push back against corset wearing, overall, most women wore them and found them to be a necessary part of their wardrobe, similar to the bra today (Gibson, 2020). Like fashion today, corsets were worn in many different ways, but they were typically universally worn by women (Gibson, 2020). Still, some women did not wear corsets while others took it to the extreme by lacing their corsets incredibly tight (Gibson, 2020).

Figure 1 Over bust Corset 1890 (Victoria and Albert Museum)

Figure 2 Under bust Corset 1860s (Victoria and Albert)

The bustle was a fashion trend that arose later than the corset, during the 1800s (Figures 3 and 4). With this new addition, women could accentuate their unnaturally thin waists even more than before. Specifically, the bustle came in fashion around the 1870s and continued through the end of the century and the beginning of the next (Bowman, 2016). The shape of the bustle changed as much as the shape of the corset (Bowman, 2016). It started as a way of gathering the skirt fabric to the back of the dress in order to create a straight, flat front (Figure 4) that was more practical than the large crinoline skirts (Figure 3) that came before (Bowman, 2016). The bustle was constructed with the fabric from the skirt as well as the use of a "shape improver…small cages, cushions or pads, stuffed with horsehair, down, or even straw." (Bowman, 2016, p.103). During this period, bustles went through many transformations increasing and decreasing in size. At one point, around the late 1870s, it almost disappears, and the corset compensated for this by being extremely tight laced to create the appearance of thinness (Bowman, 2016). Like different kinds of corsets, there were many different kinds of bustles that served a variety of purposes, but mostly the style and preference of the women wearing them.

Figure 3: Cage Crinoline Skirt 1860-1865 (Victoria and Albert)

Figure 4 Crinolette Bustle 1870 (Victoria and Albert)

Towards the middle of the Victorian era, in the height of the romantic movement, there arose a unique fashion trend of consumptive chic. This obsession with the disease known as consumption at the time, now known as tuberculosis, came from the disease being romanticized in art and literature. In order to mimic the wasted-away appearance caused by tuberculosis, tight-lacing corsets and starvation diets become popular (Dormandy, 2000). Young women would drink lemon juice or vinegar in an attempt to lessen their appetite and some would use lead or arsenic make-up to appear unhealthily pale and sickly (Cormandy, 2000; Whorton, 2010). This fashion trend even impacted men to a lesser degree, depicting men who were emaciated as artistic geniuses (Dormandy, 2000). These extreme fashion choices were not necessarily the norm, they were fads or trends that mainly the upper classes or the bourgeois class could adopt. This was for the simple reasons of affordability and privilege. Especially where tight lacing was concerned, the wealthier classes could afford to be constricted in a way that would limit mobility because these women would not be working while the lower-class women needed to be able to complete daily tasks and jobs. This concept of fashion mimicking a serious disease can also be seen in the 1990s with the

"heroin chic" trend that emphasized extreme thinness with bags under the eyes. The heroin chic trend came from a glamorization of drug addiction and overdoses during the early 1990s. These fashion fads do not always last very long, maybe a decade or so, but their impact on the body and the skeletal structure can be observed.

2.3 Literature and Art in the 19th Century

In the 1790s, America saw an influx of Gothic novels imported from England and Germany by authors Ann Radcliffe, Horace Walpole, Clara Reeve, and Matthew Gregory Lewis (Ringe, 1982). These books by renowned Gothic authors were imported in increasing quantities throughout the United States. As this genre grew in popularity, some of the books started being published by American publishing houses, indicating the popularity of the Gothic genre. These books in turn influenced American literature, creating the American Gothic style. Looking at English Gothic writing, there is a clear sense of looking back and nostalgia (Ringe, 1982). For the British, this nostalgia tended to revolve around castle ruins and ancient estates, looking back to the medieval era (Ringe, 1982). The American Gothic style reflects this, but in a different way. Since America does not have the same medieval history as England and Germany do, the nostalgic style is more reminiscent of a longing for these grand estates and old families, a mythical and imaginary past.

The Gothic style in American literature can be seen in writers like Edgar Allan Poe, Nathanial Hawthorne, and Charles Brockden Brown (Punter 1980). These authors were influenced by the imported English Gothic novels of the time, but changed and adapted the style to fit American culture and their own experiences. In order to try to capture and imagine a historical past, like the English Gothic writers achieved, these writers created the "distinctive features of American Gothic: its darkness, its tendency towards obsession, its absorption with powerful and evil Europeans," (Punter, 1980). What also characterized English and American Gothic and Romantic literature was this sense of woefulness in many of the heroines and heroes. For example, in Edgar Allan Poe's "Fall of the House of Usher" and in the poetry of Dante Gabriel Rossetti and John Keats.

Depictions of the tubercular ideal of beauty can be seen in Edgar Allan Poe's "Annabel Lee," where a beautiful maiden with shining eyes dies while in the height of youth (Poe, 1849). This poem was written about Poe's wife, who died very young, aged 24, from tuberculosis. This idea

of a tragic, virtuous death that preserved youth while in its prime can be seen in other Gothic works as well as some of Poe's short stories. While this ideal of beauty is readily apparent in many European poems and novels, the main example in American literature is Poe's works. "The Fall of the House of Usher" focuses on a sentient house and an ailing family. In this story, Madeline and Roderick Usher are the last in their family and it is clear from the narrator's perspective that there is something off about them. Madeline has a mysterious and undiagnosable illness, but from Poe's description, it could be tuberculosis. Madeline suffered from, "a settled apathy, a gradual wasting away of the person, and frequent although transient affections of a partially cataleptical character," (Poe, 1840). This description could fit a tuberculous person, though it is clear in the story that it was not possible to make a definititive diagnosis. Later in the story, when Madeline dies, the narrator helps Roderick move her body to the family tomb and he notices, "[t]he disease which had thus entombed the lady in the maturity of youth, had left…the mockery of a faint blush upon the bosom and the face," (Poe, 1840). While the disease is supposed to be fantastical and almost supernatural in nature, the similarities to tuberculosis are apparent.

The illusions to the disease that took many young people at the time are strong and increase the romantic and beautiful ideals associated with the disease. When the narrator describes Roderick Usher, he mentions many of the typical traits of consumptive chic: "A cadaverousness of complexion; lips somewhat thin and very pallid, but of a surpassingly beautiful curve; a nose of a delicate Hebrew model, but with a breadth of nostril unusual in similar formations; a finely moulded chin, speaking, in its want of prominence, of a want of moral energy; hair of a more than web-like softness and tenuity; these features, with an inordinate expansion above the regions of the temple, made up altogether a countenance not easily to be forgotten." (Poe, 1840). While this is not exactly the ideal of consumptive chic that is portrayed in paintings, it has many similarities with the mention of the corpse-like skin and glassy, fever-like eyes. This style of beauty can be seen in some of his other short stories and poems and promotes the romanticization of tuberculosis and how it impacted the ideals of beauty at the time.

One of the most famous and influential poets who romanticized tuberculosis was Percy Bysshe Shelley. Unlike Poe who portrayed this ideal of beauty primarily in women, Shelley's major work that impacted how tuberculosis was viewed was a eulogy to John Keats. Percy Shelley was an English Romantic poet and was married to Mary Shelley, who wrote *Frankenstein.* Shelley's work

is notable in how he continues the trend of romanticizing tuberculosis. Society's view of tuberculosis as a romantic disease was increased by the death of the English poet, John Keats (Lawlor, 2006). He died young at 25 of tuberculosis, adding to the romanticizing of the disease (Lawlor, 2006). Percy Shelley wrote *Adonais* about the death of his friend Keats, which added to the idea that tuberculosis was a disease of the young and artistic (Lawlor, 2006).

> *He has outsoared the shadow of our night;/Envy and calumny and hate and pain,/And that/unrest which men miscall delight,/Can touch him not and torture not again;/From contagion of the world's slow stain/He is secure, and now can never mourn/A heart grown cold, a head grown grey in vain;/Nor, when the spirit's self has ceased to burn,/With sparkless ashes load an unlamented urn* (Shelley, 1927, p. 20).

This stanza in *Adonais* shows how Shelley idolized the young poet. He writes how Keats soared above everyone else, referring not only to his path to heaven but also his poetic skills. In doing this, Shelley reinforces the idea that tuberculosis creates a kind of fevered genius in poets. This stanza also immortalizes Keats' legacy as a poet and his pure, untainted soul. The idea that tuberculosis was attractive to young people may have partially derived from a coping mechanism of atonement where the death of a young person from tuberculosis showed that their souls were pure and not yet corrupted by life's hardships (Dormandy, 2000). This idea of tuberculosis is represented in Shelley's elegy for Keats' life and death. On top of this, Shelley was himself most likely tuberculous, though he died by drowning. Shelley wrote many poems of the Romantic genre, though he also contributed many political poems and treatises.

John Keats had an extremely long and personal relationship with tuberculosis starting with the death of his mother (Lawlor, 2006). While he was caring for his tubercular brother, Keats wrote one of his most famous and beautiful poems, "Hyperion," (Lawlor, 2006). This poem shows Keats' feelings and despair while caring for his brother, Tom. He writes, "Deep in the shady sadness of a vale/Far sunken from the healthy breath of morn," as the first lines of the poem (Keats, 1818). These lines show Keats' depression while caring for his dying brother. Within this poem as well, the reader can find a sense of beauty. He writes about a grieving goddess: "How beautiful, if sorrow had not made/Sorrow more beautiful than Beauty's self," (Keats, 1818). These lines, while steeped in grief, show a quietly beautiful side of sadness. In this way, Keats is displaying the characteristic of unguarded emotions that is one of the defining features of Romantic literature. In this way, he

also romanticizes death and grief which promote the idea of a young death as desirable and attractive.

Possibly before Keats nursed his brother on his deathbed, Keats himself contracted tuberculosis. The first account of his illness, however, is in late winter after his brother died when he rode home on the top of a coach and caught a chill (Lawlor, 2006). When his friend helped him to bed, he started coughing up blood to which he said, "I know the colour of that blood; - it is arterial blood; - I cannot be deceived in that colour; - that drop of blood is my death-warrant; - I must die," (Lawlor, 2006, p.135). Keats had trained as a physician before switching to poetry, so he knew the signs of tuberculosis and that it likely spelled death for him (Dormandy, 2000). This painted the young poet as a tragic figure and only increased his fame after his death (Dormandy, 2000).

Dante Gabriel Rossetti was an English poet and one of the founders of the Pre-Raphaelite Brotherhood. While Rossetti's poetry contains a number of references to a romantic view of tuberculosis, he is more known for his artwork that provided a visual depiction of this ideal of beauty. The Pre-Raphaelite society was a group of painters and artists who pulled inspiration from art created before Raphael (Fleming, 1967). The members promoted Quattrocento Italian art and found the contemporary art of their time to be too neoclassical (Fleming, 1967). Through this, he met Elizabeth Siddal who became his muse and later his wife. Elizabeth embodied what Rossetti thought was the epitome of ethereal beauty. Many of the members of the brotherhood asked her to be their model. While Rossetti's poetry shows some examples of a romanticized view of tuberculosis, his paintings portray this ideal of beauty. This may be because of Elizabeth Siddal since she was herself tuberculous and Rossetti was obsessed with her. In one painting, *Beata Beatrix* (Figure 5), Rossetti depicts his despair at the death of his wife (Fowle, 2000). Rossetti is relating his love for Elizabeth with that

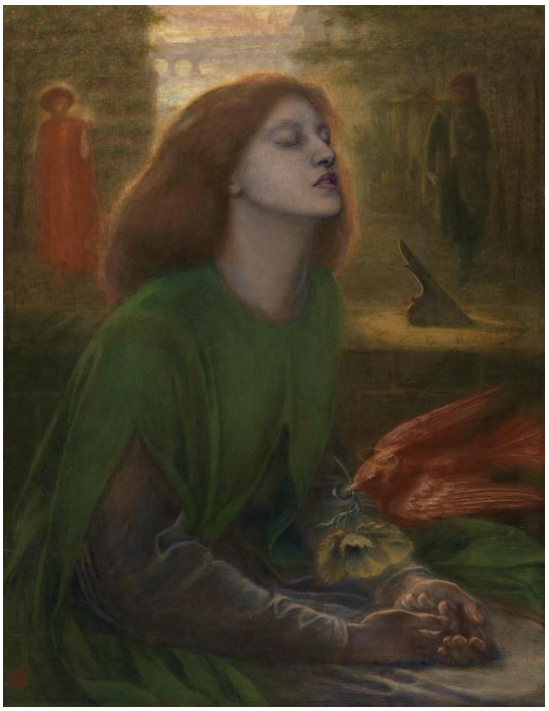


Figure 5 Beata Beatrix by Dante Gabriel Rosetti 1864-70 (Tate Gallery)

of Dante Aligheri's for Beatrice Portinsri. Through his depiction of Elizabeth in Figure 5, Rossetti shows the parallels between the two women who were deeply loved and mourned. In this painting, Rossetti portrays death in a beautiful, incandescent light. Elizabeth is depicted in a medieval-style dress with her face tilted toward the sky, with a peaceful expression. She is pale and thin while awaiting death but is still shown as beautiful. Behind her is an angel holding a flame and Rossetti

Figure 6 Ophelia by Sir John Everett Millais, 1851-52 (Tate Gallery)

standing somberly across from it (Fowle, 2000). A dove with a halo carrying a poppy flower is alighting on Elizabeth's lap, indicating death and sleep as well as the holy spirit (Fowle, 2000). It also refers to her addiction to laudanum which ultimately led to her death by overdose which was brought on by her deteriorating mental health and her suffering from long-term tuiberculosis (Fowle, 2000; Flemming, 1967).While this painting does not overtly depict a tuberculous idea of beauty, Elizabeth is still very pale and thin in the painting, and she dies of tuberculosis which could have added to supposed allure of the disease (Flemming, 1967).

Another painting of Elizabeth Siddal displays more distinct characteristics of consumptive chic. Sir John Everett Millais painted Elizabeth as Ophelia in his painting of the same name (Figure 6)

(Riggs, 1998). In this painting, Ophelia is shown in her death scene from *Hamlet,* lying in a stream surrounded by flowers. In the play, the character Ophelia uses flowers in her madness to say something about the character she was giving them to, so in the painting, all of the flowers have a special significance. Millais used roses to signify love as well as the willow and daisies to mean innocence and forsaken love (Riggs, 1998). Similar to Rossetti, Millais also uses the poppy to allude to death (Riggs, 1998). In order to paint Ophelia, Millais had Elizabeth pose in a bathtub over a period of four months, which, to the tubercular woman, was detrimental to her health (Riggs, 1998). In the painting, one can see the signs of consumptive chic: the flushed cheeks and pale skin, a frail delicateness, and fever-shined eyes.

The Pre-Raphaelite brotherhood created and perpetuated a form of beauty that resembled the appearance of a tubercular person. While this is especially evident in their paintings of women, this aesthetic also applied to men at the time. Not only was it fashionable for the young people of the upper classes to display tubercular attributes, but it also signified a sense of innocence, genius, and purity (Dormandy, 2000).

2.4 Tuberculosis in the 19th Century

Tuberculosis has been present in prehistoric human societies and there is even evidence of it in Egyptian mummies (Dormandy, 2000). Needless to say, it has plagued humanity since well before the 1800s and still today is the second leading cause of death from infectious disease after COVID-19 (WHO, 2022). Tuberculosis is an infectious disease that can be spread through the air by cough (WHO, 2022). The infected droplets are inhaled and lead to a primary infection in the lungs, known as pulmonary tuberculosis (Waldron, 2020). This infection can be spread to virtually any part of the body, the most common in the archaeological record being spinal tuberculosis or Pott's disease as it directly affects the bones (Waldron, 2020). Crowded places, like cities, can increase the rate of the spread of disease due to unsanitary conditions and the increased population (Waldron, 2020). By living in closer quarters, it is easier to spread the disease through coughing or sneezing. During the beginning of the 19th century, there was an increase in the prevalence of tuberculosis, or what appeared to be tuberculosis, and it killed many people before they reached adulthood as well as many young adults (Waldron, 2020; Dormandy, 2000).

This disease was called by many names, one of the most common being consumption as well as the White Death, phthisis, and the wasting disease (Dormandy, 2000). The use of many different terms and the lack of a clear and distinct definition could have added to the confusion of what tuberculosis actually was as well as the diagnoses at the time (Dormandy, 2000). Just as the disease had many names, it also had many supposed cures. Many doctors at the beginning of the 19th century would prescribe a regimen of bloodletting, rest, and bland and little food (Dormandy, 2000). The combination of blood loss and starvation could end a patient's life before the disease would. On top of this, some doctors would follow the recommendation of Dr. Robert Bree who had become famous with his cure for asthma (Dormandy, 2000). This cure was digitalis which happens to be an extract of foxglove leaves. According to the Lewis Dictionary of Toxicology, "all parts of the plan are highly toxic." While digitalis in small amounts can help with heart conditions like congestive heart failure and heart arrhythmia, too much can poison a person and could be fatal (Texas Heart Institute, 2023; Lewis 1996). Dr. Bree published a treatise on digitalis and its health benefits, but the dosage he recommended would be fatal if administered as he directed (Dormandy, 2000). Some other cures that were also suggested at the time were cupping as well as the ingestion or application of cod-liver oil, mercury, donkey's milk, and even blood (Dormandy, 2000).

While the medical field struggled to come up with a distinctive cure for consumption, a unique phenomenon occurred through a literary movement. In response to the Age of Enlightenment before it, the Romantic Movement encouraged emotions and feelings in works of art. It focused on the individual and an idealized form of nature, condemning industrialization and looking towards the medieval past. The Romantic Movement influenced literature, art, and music primarily from 1800-1850. This movement, especially in the mid-1800s, romanticized tuberculosis. Many beloved artists and writers suffered from consumption, and it was considered a beautifully tragic way to die. Many believed that tuberculosis provided the genius that these people possessed with its long periods of low-grade fevers (Dormandy, 2000). It progressed to being an attractive way to die which in turn influenced fashion. Having tuberculosis was soon associated with artistic genius or virtue and purity (Dormandy, 2000). This association rose during this time, especially as a way to explain why so many young people were taken before or in the height of their prime because of this disease (Dormandy, 2000). Tuberculosis was considered sacrifice or atonement and gathered an almost religious fervor around the belief as a means of coping with the tragedy (Dormandy, 2000).

2.5 Effects on the Skeleton and Pott's Disease

Figure 7 Kyphosis due to Pott's Disease (Waldron, 2020)

Tuberculosis is one of the few infectious diseases that can affect the skeleton. The most distinct skeletal change is to the vertebral column and is called Pott's Disease refering to tuberculosis of the spine. The disease causes lytic lesions in the vertebral bodies, causing vertebral collapse in some places (Waldon 2020). Lytic lesions are destructive lacerations where cells are destroyed due to pathology. This collapse can be seen in vivo causing a kyphosis, colloquially known as a hunchback (Dormandy, 2000).

2.6 Theoretical framework

For this project, the data was analyzed through the lens of materiality and the connection between the body and culture. Much of the current literature on materiality within the field of archaeology focuses on grave goods and material culture, without considering the body as a material object. However one can conceptualize the body as material when considering ways it is shaped by experience and identity (Sofaer, 2006; Monetti, 2022). Embodiment theory works well with this project as a way of viewing corset wear and culture in Philadelphia. Embodiment theory can be used in this project by interrogating how corset wear could be considered an embodiment of European culture and ideals. This is especially true when looking at the ideal of beauty portrayed in European literature and art and how it is embodied in corsetry as a means of altering one's body to fit the ideal.

2.7 Conclusion

This chapter discussed the ideals of beauty influenced by tuberculosis that are presented in European art and literature as well as American literature. A way that tuberculosis influenced fashion was in the corset, which was sometimes tight-laced by upper class women to create an extremely thin figure. The next chapter will present the materials and methods used for this project which helped to address the research question posed which is: Were the embodiment of European

ideals of beauty that was related to consumptive chic materialized in the skeletons of the individuals from the Arch Street assemblage?

Chapter 3: Materials and Methods

3.1 Introduction

This chapter outlines the materials and methods that were used for this research project. The materials listed are both the skeletal remains as well as the equipment used. The methods section lays out the methods that were used as well as the development of a standard method for measuring ribs for fashion-related morphological changes. These fashion-related changes or lack thereof can then inform the culture surrounding the ideal form of beauty and as a proxy the literature in America. The culture impacted the literature which then impacted the popular fashion at the time causing morphological changes that have been recorded in previous studies.

3.2Materials

3.2.1 Arch St. Project

The materials used for this project were ten archaeological human skeletons from the Arch Street Project in Philadelphia. These remains were analyzed in part at Drew University as well as at Rutgers Camden with the help of Professor Kimberlee Moran who oversees the collection there. These remains come from a cemetery that was rediscovered after a construction project for a parking deck uncovered remains at the site (Moran, 2018). Professor Moran, Anna Dhody, and Dr. Ani Hatza researched the site and learned that the remains from the cemetery were supposed to have been moved to the Mt. Moriah Cemetery in 1860. They realized when they visited the site that there would likely be more bones that would turn up as the construction moved to the Southwest side of the site (Moran, 2018). As they had suspected, more bones, and eventually full coffins, showed up as the construction continued, indicating that the full cemetery was not relocated in 1860 as historical documents had suggested (Agreement to remove burials to Mount Moriah Cemetery, 1860). Professor Moran and her team asked the construction developer again if they could excavate the remains as they felt that it would be unethical to abandon the remains at the construction site (Moran, 2018). The developer gave them only a week to excavate the site and the team made the most of their time, managing to excavate over 100 individuals (Moran, 2018). Since the initial excavation, a follow-up one was conducted by a hired company and now there are about 500 burials excavated (Moran, 2018). This collection is where the majority of the data and sources for this project come from.

3.2.2 History of the Site

Taking into consideration that these remains are from an abandoned cemetery is important when trying to understand the history of the people who were buried there. This cemetery was owned by the First Baptist Church in Philadelphia which moved locations as the congregation grew (Moran, 2018). When the church moved to its current location, the cemetery at the old site fell into disrepair (Moran, 2018). The First Baptist Church bought a plot in Mount Moriah Cemetery and put a notice in the paper, letting the community know that they were planning on moving the remains of the individuals who were buried at Arch Street to the new plot, and they signed an agreement stating that all remains would be moved by "the Thirty first day of March A.D. One thousand eight hundred and sixty" (Moran, 2018; Agreement to remove burials to Mount Moriah Cemetery, 1860). The First Baptist Church was a large and flourishing congregation in Philadelphia, gaining prominence in 1746 when it gained independent status (Philadelphia Congregations Early Records, 2023). This shows that since the church was frequented by many Philadelphians, the cemetery would show a good distribution of people from varying socioeconomic statuses, reflective of the demographics of the city (Philadelphian Congregations Early Records, 2023; Inscriptions copied from tombstones and monuments, 1859). The Arch St. cemetery was open from the eighteenth century until 1860, providing a period of at least 100 years which overlaps with the time period when corsetry was in fashion. Corsetry existed in some form for about 300 years, and it changed considerably during that time. By looking at a cemetery that was only open for 100 years, it narrows down the type of corsetry used and therefore how that corsetry impacted the morphology of the skeleton.

3.2.3 Materials-Skeletal Remains

For this research, the archaeological skeletons of ten individuals were analyzed and compared with a modern anatomical model to identify differences across time. None of the skeletons presented lesions consistent with skeletal tuberculosis or Pott's disease. Of the archaeological remains, most were estimated to be probable female (Buikstra and Ubelaker, 1994; Kales et al., 2012). The two individuals who were of indeterminate sex were selected because of the preservation of their ribs as well as their age estimation which was older adolescent/young adult (Buikstra and Ubelaker, 1994; Kales et al., 2012). The selection criteria were that the individuals should be probable female as well as have a high preservation of the ribs. Humans are not extremely sexually dimorphic animals, but there are some differences that can help estimate sex in skeletal remains. The most

accurate method for estimating sex is by looking at the pelvic inlet, the preauricular suclus the greater sciatic notch, the ventral arc, the subpubic concavity, and the ischiopubic ramus ridge on the pelvis (Buikstra and Ubelaker, 1994). When the pelvis was available, these methods were used to estimate the sex of the individual. When the skull was present, it was also used for sex estimation using the methods presented by Buikstra and Ubelaker (1994). For this method, the nuchal crest, the mastoid process, the supra-orbital process, the glabella, and the mental eminence were analyzed on a scale of 1-5 with 1 being the least robust and 5 being the most.

In the Arch Street Project, each grave that was excavated was assigned an alphanumeric code that referred to the university where they would be stored, Rutgers University, and a three-digit number. The first individual that was analyzed for this project was RU-020 who was estimated to be probable female and had very gracile features. Individual RU-027 was also probable female and had a number of thoracic vertebrae for the measurement of the spinous process angle. For individual RU-056, there was a full skull which was useful for determining sex estimation. RU-029 was an interesting case as the vertebrae displayed a pathological condition that was diagnosed as Diffuse Idiopathic Skeletal Hyperostosis or DISH. While the ribs were unaffected by the osteophyte growth on the vertebrae, the lesions made it difficult to measure the angle of the spinous process with any consistency and reliability. RU-011 was probable female and had thoracic vertebrae T1-T9 which showed changes in the spinous process angle within the vertebral column. Individuals RU-022 and RU-002 were both probable females and had relatively well-preserved ribs. While RU-019 displayed gracile features, the sex estimation was indeterminate overall. Due to the generally gracile features, however, the skeleton was included. Both RU-001 and RU-009 were of indeterminate sex but were included in part because of the preservation of their ribs, but also to see if there were any significant morphological changes in the vertebrae and ribs similar to what was hypothesized about the probable female individuals.

3.2.4 Materials- Equipment

Sliding calipers were used to measure the ribs, while a goniometer was used to measure the angle of the spinous process. A Canon Powershot SX540 HS was used to take photos of the ribs and vertebrae. A box with black sand and a photo scale was used for the photos. The photos were analyzed using ImageJ, an imaging software platform, and the data gathered from that process were entered into RStudio for analysis using the R coding language. Current literature on

paleopathology, history papers on daily life, pre-Raphaelite art, and Victorian poetry and literature were used as well for framing the results within archaeological and historical context.

3.3 Methods

3.3.1 Biological Profile

The biological profile was estimated using the standard methods presented by Buikstra and Ubelaker (1994) as well as looking at the database provided by the Arch Street project. By using the database, it became easier to sort through the inventory to find boxes that contained a minimum number of individuals (MNI) of 1 and were probable females. After determining this, a sex estimation was conducted independently using the standards mentioned above.

3.3.2 Method Development

In order to determine if there was evidence of long-term corseting on the remains from the Arch Street project, a standard method for measuring ribs needed to be determined. Dr. Rebecca Gibson has done extensive research on the impact that corsets had on the body. By reading her article, "Effects of Long Term Corseting on the Female Skeleton: A Preliminary Morphological Examination." and her book, *The Corseted Skeleton: A Bioarchaeology of Binding*, some basic methods for measuring the ribs could be perceived (Gibson, 2015; Gibson, 2015). The issue with these sources was that when Dr. Gibson explained her methods, she did not do so in a way that could be easily replicated as her analysis was rooted more in history and so a detailed explanation of the osteological methods was not given (Gibson, 2015). For the museum specimens she studied, which were supported by wires to be articulated, she measured the circumference of the ribs which effectively showed the curvature, (Gibson, 2015). However, for archaeological remains, it was more difficult to deduce what methods had been used, as the bones were disarticulated, making the circumference difficult to measure. The author said, however, that the circumference was predicted based on the following formula:

$$C=2\pi r$$

(Gibson, 2015) This formula is the typical mathematical equation for determining the circumference of a circle where "C" is the circumference and "r" is the radius of the circle. This method was challenging to follow and replicate with fragmented, archaeological remains though as the vertebrae were not always present or intact and the ribs were sometimes severely

fragmented. This as well as the fact that the rib cage is never a perfect circle, made determining the radius of the ribcage or rib difficult. While Dr. Gibson does mention that she used archaeological remains, she does not mention how she overcame the problem of rib fragments and missing or damaged vertebrae.

In order to create a replicable method that could accurately measure more fragmented remains, a combination of previous methods and some trial and error were used. Dr. Gibson's method of measuring the angle of the spinous process was extremely useful to include as it indicated the external shaping of the skeleton over a long period of time. Dr. Gibson uses this as an indicator of long-term corseting, which is clearly and effectively discussed (Gibson, 2015), but this angle can also indicate other pressures, changes in fashion, and possible pathologies that are in their early stages (Gibson, 2015). More research is needed to determine the full extent of information and data that can be gathered from the angle of the spinous process. For the rib measurements, Franciscus and Churchill (2002) was extremely useful in laying out specific measurements as well as presenting a detailed and clear diagram that was used in the construction of the methods presented in this research (Franciscus and Churchill, 2002). Another paper, "The costal skeleton of *Homo antecessor:* preliminary results" by Gómez-Olivencia and colleagues (2010) used the methods presented by Franciscus and Churchill (2002) which showed another application of these methods on Neandertal remains (Gómez-Olivencia et al., 2010; Franciscus and Churchill, 2002). Gómez-Olivencia et al. (2009) was also used as it addresses specifically the issues with taphonomic distortion and breakage when using the methods set out by Franciscus and Churchill (2002) (Gómez-Olivencia et al., 2009). Using a combination of these methods, both Gibson (2015) and Franciscus and Churchill (2002), a new set of methods and definitions were created for this research towards standardizing a set of methods that can be applied to an archaeological context with fragmented remains (Gibson, 2015; Franciscus and Churchill, 2002). Standardization and repeatability are important in scientific research because reconducting studies is vital to the scientific method and proving or disproving hypotheses.

Using the diagram in Figure 8, from Franciscus and Churchill (2002), the following definitions were adapted by the author and applied so that they more accurately reflect what could be used for archaeological remains. These definitions were derived from the list in Franciscus and Churchill (2002) as well as trial and error using ribs from a disarticulated anatomical model to eliminate the issue of taphonomic distortion and breakage while developing the methods. While using the

definitions provided by Franciscus and Churchill (2002), there were some issues in clearly understanding how to interpret the language used which is why these new definitions were written, partially for clarity and partially for their application to archaeological human remains instead of Neanderthal fossils. When using these methods, the numbers of the definitions match up with the numbers on the diagram. It is necessary when applying this method to consistently hold the rib in anatomical position for more consistent results, except for the first measurement where the rib needs to be held with the costal groove facing up.

1. Tubercle-iliocostal line distance (TID)

   Distance between the midpoint of the articular tubercle to the end of the iliocostal ligament attachment (or the start of the curve of the rib where it is slightly more robust)

2. Posterior angle chord (PAC)

   Twice the distance of the tubercle-iliocostal line (best done using a photograph and imaging software to mark the landmarks and imaginary points on the image)

3. Posterior angle subtense (PAS)

   The distance from the end of the tubercle-iliocostal line to the midpoint of the posterior angle chord (best done using a photograph and imaging software to mark the landmarks and imaginary points on the image. The intersecting lines should form a right angle)

4. Posterior Angle Index (PA-INDEX)

   (PAS/PAC) x 100

5. Shaft maximum diameter at angle (SMXD)

   The height of the rib at the end of the iliocostal line

6. Shaft minimum diameter at angle (SMND)

   The width of the rib at the end of the iliocostal line

7. Shaft index at angle (SH-INDEX)

   (SMND/SMXD) x 100

8. Articular tubercle height (ATH)

   The height of the articular tubercle

9. Articular tubercle width (ATW)

   The width of the articular tubercle

10. Mid-shaft maximum diameter (MMXD)

    The height of the rib at the mid-shaft point

11. Mid-shaft minimum diameter (MMND)

    The width of the rib at the mid-shaft point

12. Mid-shaft index (MS-INDEX)

    (MMND/MMXD) x 100

13. Mid-shaft cross-sectional area (MS-AREA)

    MS-AREA=(MMXD/2)(MMND/2)

14. Neck length (NL)

    The length of the neck from the midpoint of the articular tubercle to the vertebral end. Hold the rib in anatomical position and measure until the posterior side of the vertebral end as indicated in the diagram.

15. Neck S-I diameter (NSID)

    The height of the neck of the rib in between the articular tubercle and the vertebral end

16. Neck index (NCK-INDEX)

    (NSID/NL) x 100

17. Tuberculo-ventral chord (TVC)

    The distance between the articular tubercle and the sternal rib end in a straight line (best done using a photograph and imaging software as measurement 18 uses this line as a base point)

18. Tuberculo-ventral subtense (TVS)

    The distance from the TVC to the lateral-most extant of the shaft or where the rib curves out the most (best done using a photograph and imaging software as the point where it intersects at a right angle with the TVC is an imaginary point)

19. Respiratory Area (RSP-AREA)

    RSP-AREA=0.5(0.5TVC)TVS

20. Total rib curvature index (TRC-INDEX)

    (TVS/TVC) x 100

(Franciscus and Churchill, 2002)

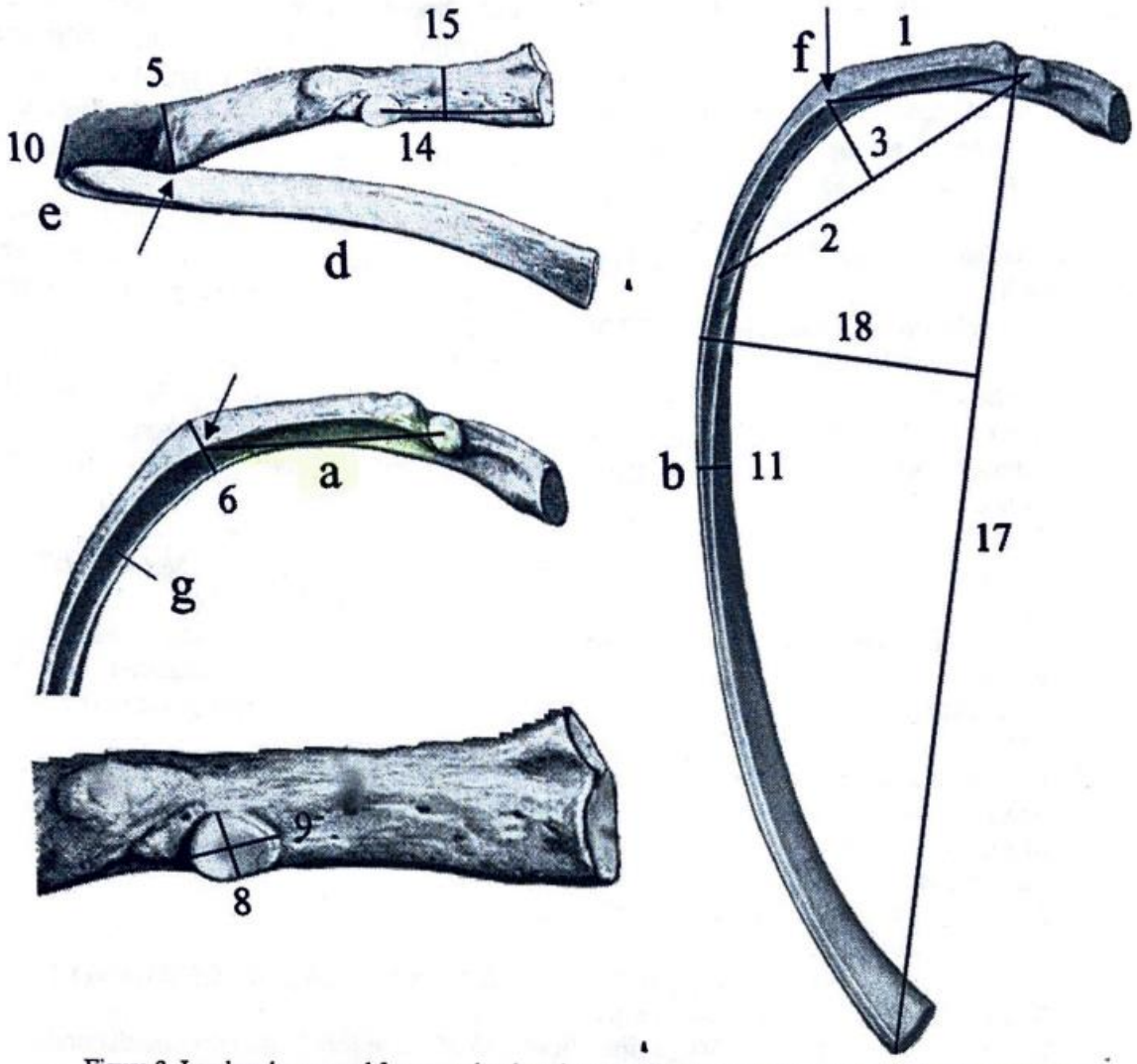


Figure 3. Landmarks, general features, chords, subtenses, diameters, and lengths used for rib sequencing and osteometric analysis as defined in the text. These are also used to calculate the indices, angles, and areas further defined in the text. The arrows indicate the location of the inferiormost point of the iliocostalis line.

Figure 8: Illustration of measurements described above (Franciscus and Churchill, 2002)

For many of the measurements and angles listed above, the application ImageJ was used to find exact measurements that can be difficult to determine using calipers or measuring tape. It was also useful for obtaining measurements 2, 3, 17, and 18 as the reference points and areas of the ribs can have subtle changes that can be difficult to see with the naked eye. All of the ribs were photographed from multiple angles in order to capture the most details. These images were then put into ImageJ, and using the angle and line features, the remaining measurements were taken. The final indices were entered in RStudio to run a PERMANOVA test in order to determine if there was any statistically significant difference. The archaeological remains were compared to a control individual that is modern, meaning that these remains would not have been impacted by corset wear.

The angle of the spinous process was measured as it was presented by Gibson (2015) that corset wear impacted the angle, making it more acute. This measurement was taken using a goniometer with one end lying flat on the superior surface of the vertebral body and the other end angling to lie flat along the spinous process.

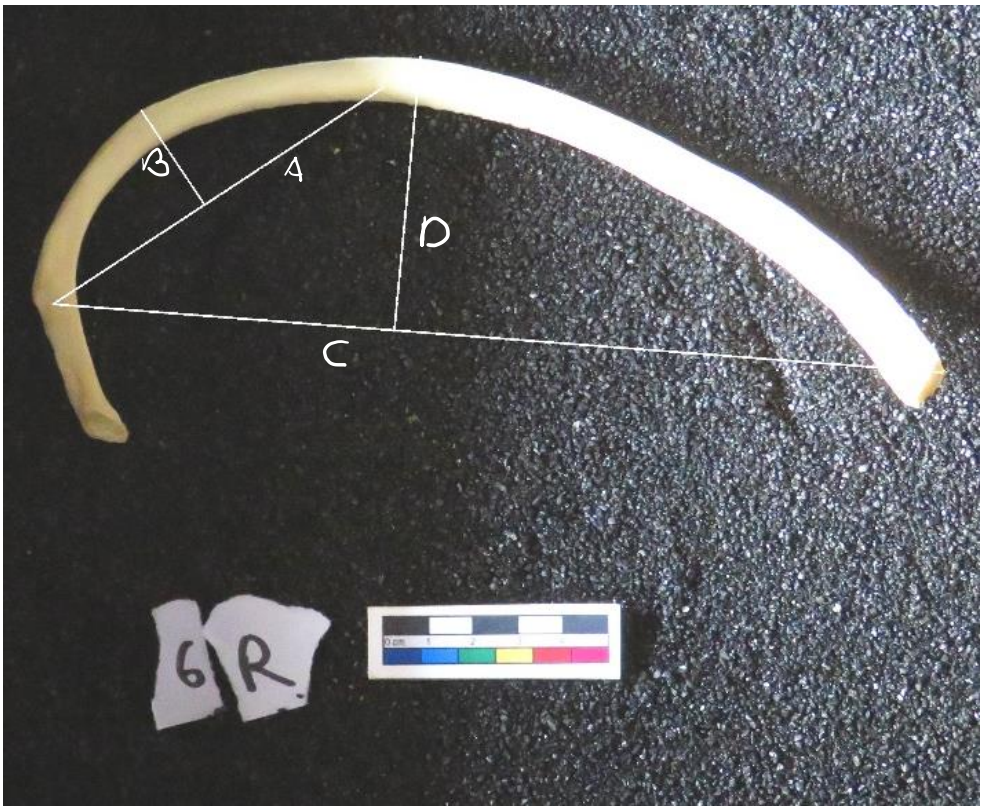
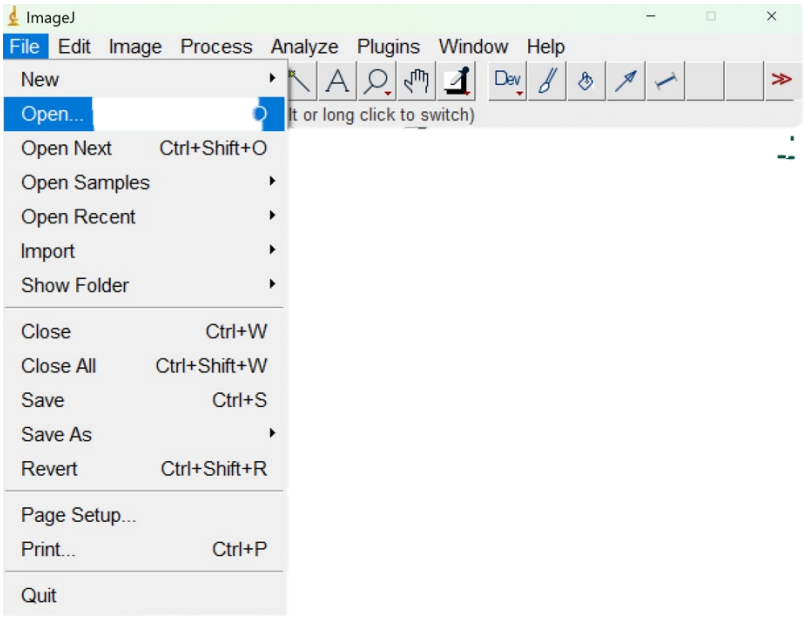


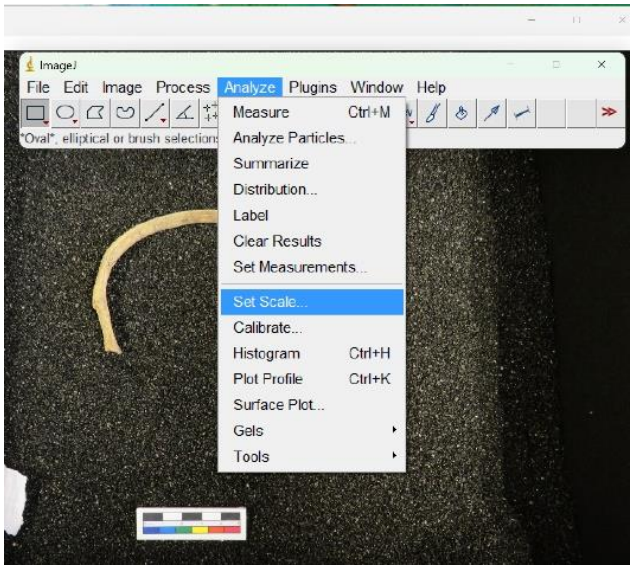
Figure 9 Rib Being Analyzed in ImageJ. Taken by the Author. This image shows the utilization of the "line draw" tool in ImageJ to determine the Total Rib Curvature. A: Posterior Angle Chord B: Posterior Angle Subtense C: Tuberculo-ventral Chord D: Tuberculo-ventral Subtense

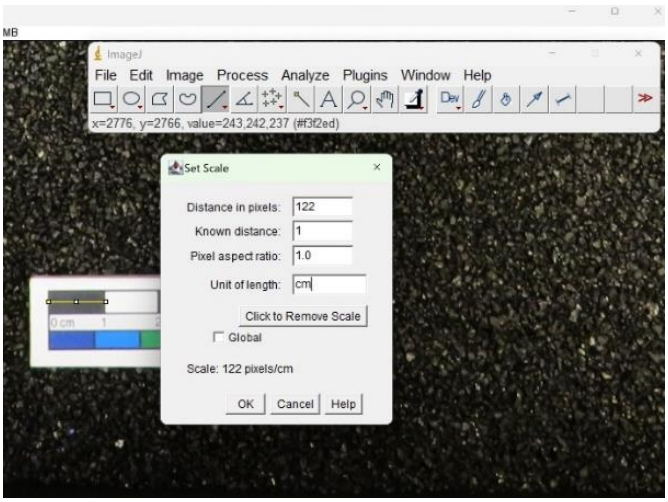
Below are step by step instructions for using ImageJ to take these measurements.

Step 1: Open ImageJ and open a file.

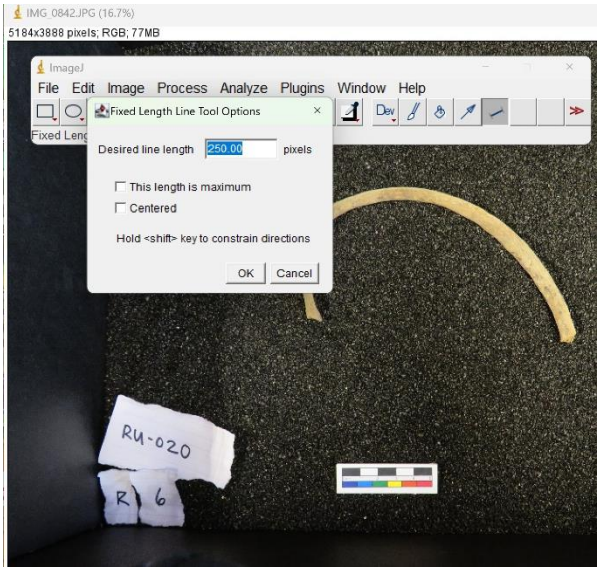


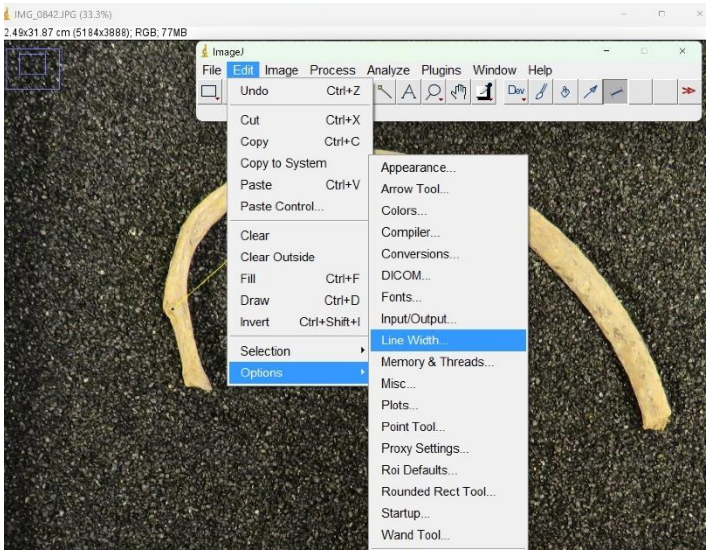
Step 2: Set scale so ImageJ is able to make accurate measurements.



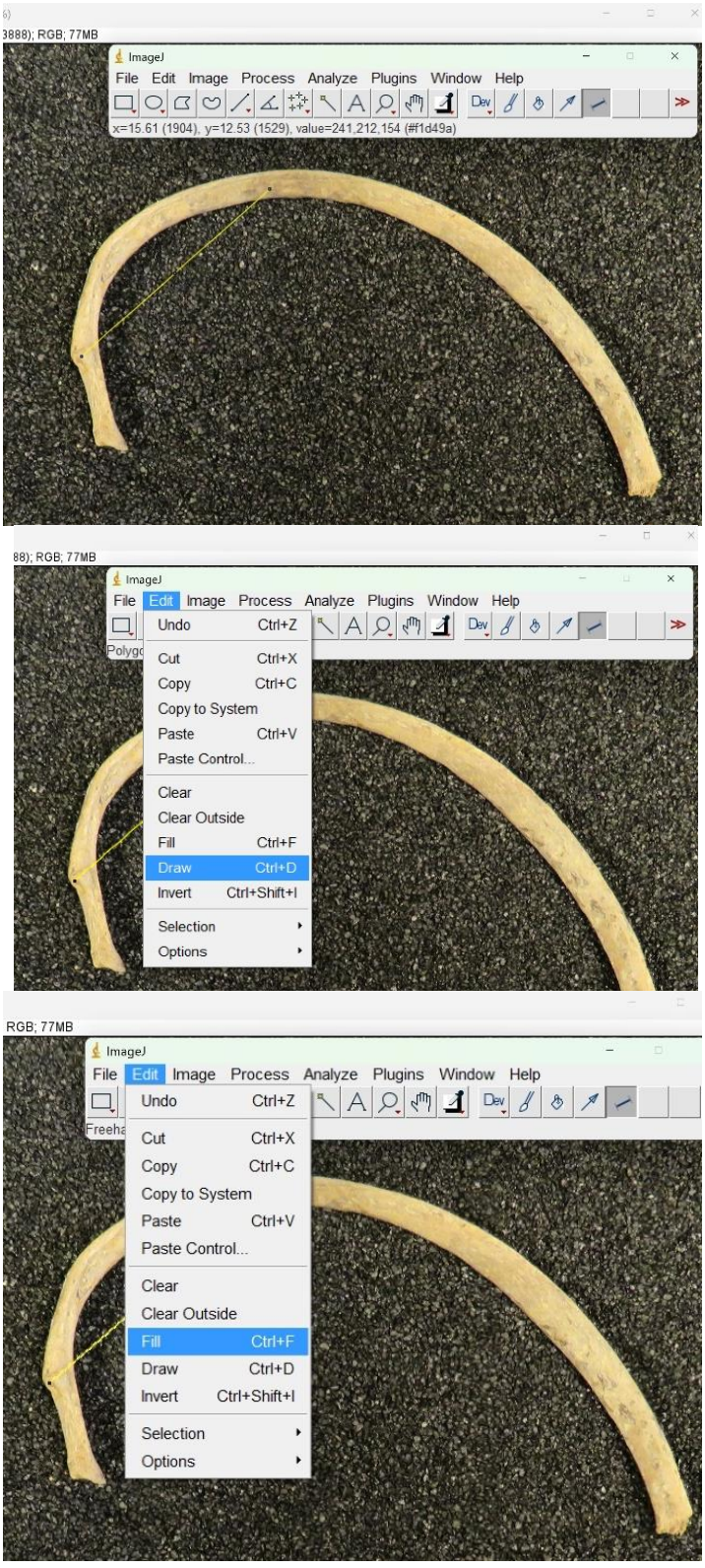


Step 3: Using the TID measurement for the rib, double it to get the PAC. Then click on the fixed line tool and set distance. Then click edit-options-line width and set the line width to 5.

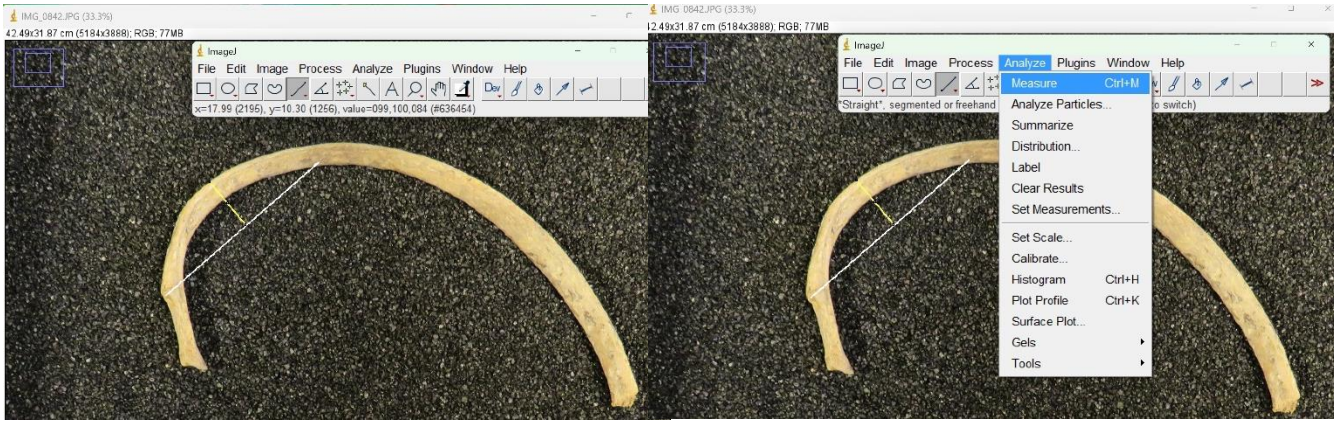


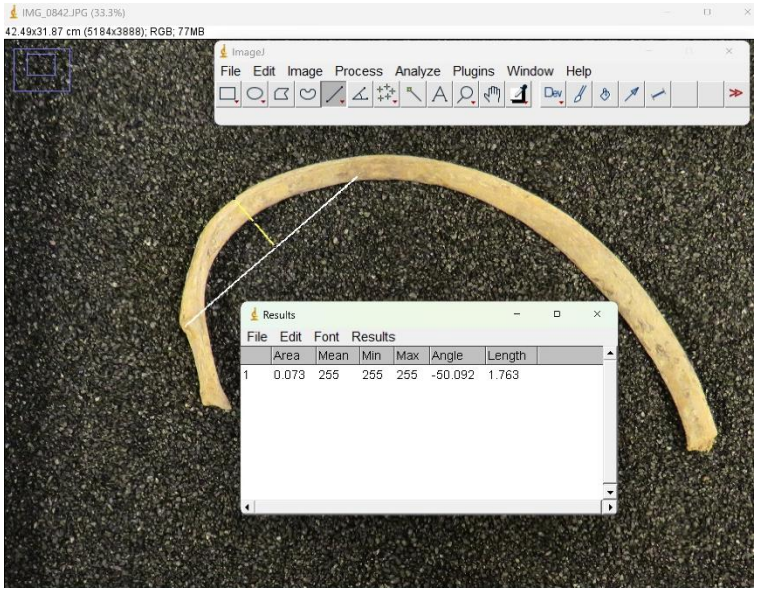


Step 4: Draw the line on the picture using the fixed line tool. Then click edit-draw and edit fill to make the line permanent.

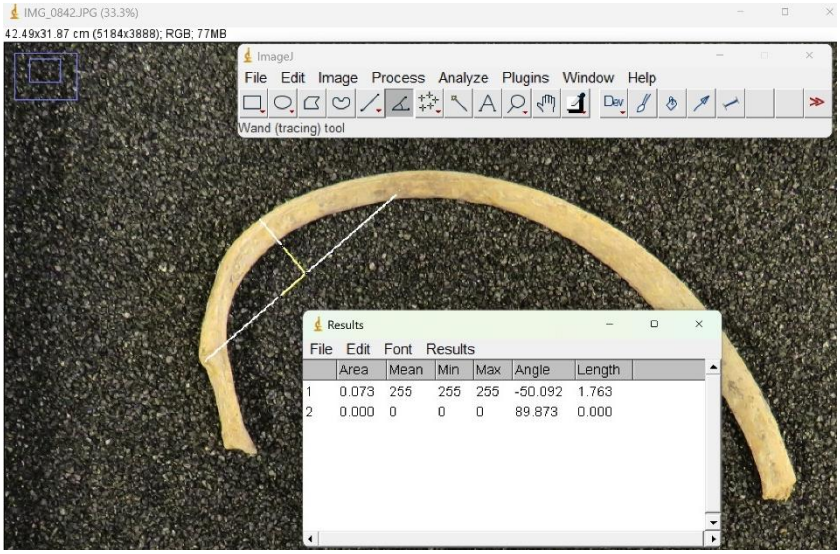


Step 5: Click on the line tool and draw a line from the iliocostal line to the midpoint of the PAC. Click edit-draw and edit-fill to make the line permanent. Click analyze-measure.

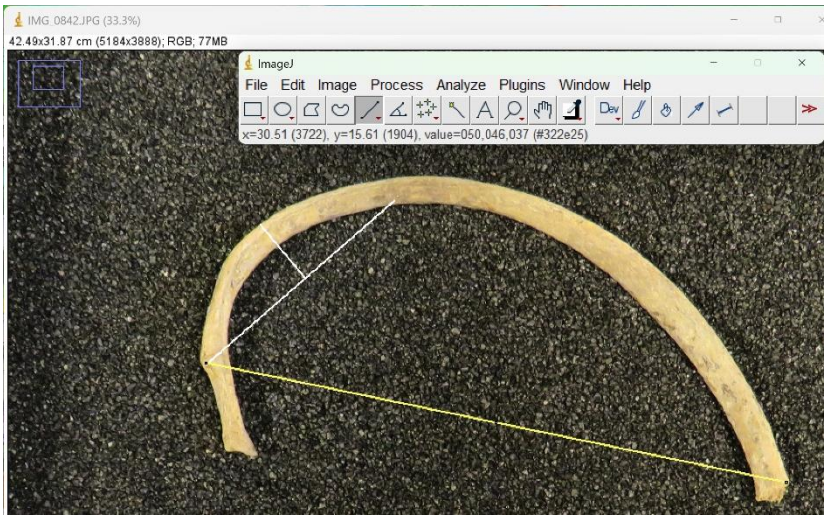




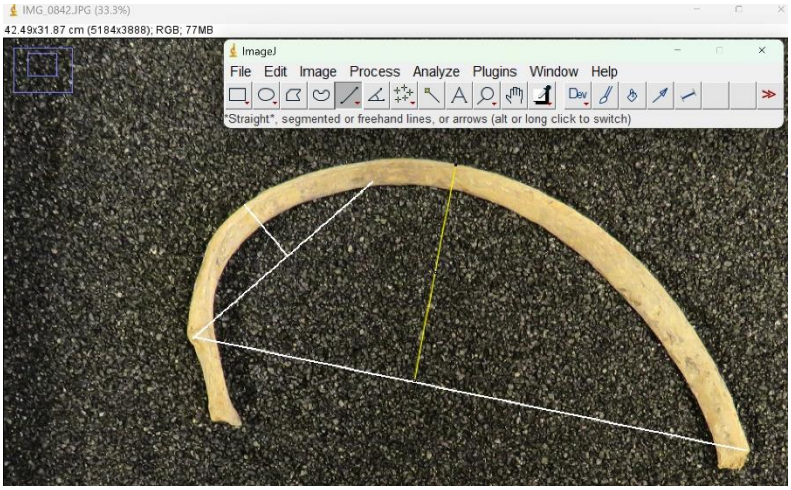
Step 6: Click on the angle tool and check to make sure the lines intersect at a right angle. Click analyze-measure.



Step 7: Click on the line tool and draw a line from the articular tubercle to the sternal end of the rib. Click edit-draw and edit-fill. Click analyze-measure.



Step 8: Using the line tool, draw a line from the lateral-most extent of the shaft to the TVC. Click edit-draw and edit-fill. Click analyze-measure.



3.4 Conclusion

This chapter presented the materials and methods that were used in this project. The measurements that were taken of the ribs in this project were initially presented by Franciscus and Churchill (2002) for the measurement of the thoracic cavity of a Neanderthal. The key points of change, the angle of the spinous process and the curvature of the rib, presented by Gibson (2015) in her article were used in this project. These points were then converted into comparable indices that were used by Franciscus and Churchill (2002). After determining all of the measurements, the data was then entered into RStudio and RStudio Cloud to analyze and visualize the data. Using the programming language R allowed for easy manipulation of the data as well as the creation of charts and graphs that are nicely formatted and understandable. The data was tested using a PERMANOVA test, which is a permutational multivariate analysis of variance. This is typically used in biological archaeology because archaeological results do not usually follow normal distribution which this test does not require.

Chapter 4: Results

4.1 Introduction

The data collection and analysis show that there is not statistically significant difference between the modern anatomical ribs that were used as a control and the remains from the Arch Street Project. The presence or absence of fashion-related morphological change would provide insight into the American view of the romanticization of tuberculosis since it is not as well represented in American literature compared to European literature. This section will present the results and describe them. The data analysis was conducted using the PERMANOVA and pairwise tests in RStudio and data visualization was conducted in RStudio as well. In this section, the results collected from the data will be presented. They will be discussed and analyzed further in the Discussions section. The results, including the data table of all indices and pairwise tables, are presented in full in the Appendix.

4.2 Posterior Angle Index

The Posterior Angle Index is the posterior angle subtense divided by the posterior angle chord. This is calculated by taking the measurement from the midpoint of the articular tubercle to the end of the iliocostal ligament attachment which is then doubled. This index then shows the acuteness of the posterior angle meaning that the larger the index number, the more acute the angle (Franciscus and Churchill, 2002).

When looking at how corsets could have impacted the shape of the rib cage, specifically for extreme and prolonged usage, a more obtuse angle would indicate that the individual may have corseted for a significant portion of their life as it would mean a more curved rib overall. The Posterior Angle Index, or PA-index, is a useful measurement for determining the curvature of the ribs, especially in archaeological remains as the ribs tend to be fragmented. In cases of fragmented ribs, the PA-index can often still be measured and calculated because it uses landmarks that are close to one another, and which can be measured even when the less robust areas of the rib are broken off.

Figure 10 Example of an extremely curved rib with a low PA-index and a high TRC-index

Figure 11 Example of a less curved rib with a high PA-index and a low TRC-index

The PA-index values were entered into RStudio where they were formulated into a graph. The initial graph (Figure 12) shows all of the right sided ribs and their PA-indices. The colors of the lines indicate the individual. The Control (CRTL), the modern anatomical ribs, are shown in black. The dots on the graph represent the exact PA-index value and the lines connecting the dots show which ribs belong to each individual. In all graphs presented in this chapter, the individuals are identified through the skeleton number from the Arch Street Project database. This graph shows how most of the PA-indices are clustered between 25 and 30 with the majority falling between 22 and 32. This shows that there is not a significant variation in the curvature of the ribs between the individuals measured. While the PA-index only represents the angle of the rib by the iliocostal line, it is still indicative of the overall curvature of the rib because it measures the initial curve at the head of the rib which shows how open or closed posterior angle is (Franciscus and Churchill, 2002). This is important when dealing with archaeological and fragmented remains which Franciscus and Churchill (2002) address in their paper as many of the fossil specimens that they work with are often incomplete and fragmented. What is interesting to note is that for the right sided ribs (Figure 12), the Control is roughly in the center of the collected data while in Figure 13, the control is towards the top of the graph. Figure 13 also shows a much broader range of numbers for the PA-indices, starting just under 19 and ending at 32 with no consistent cluster. This is curious because the right side follows a cluster pattern though there are still notable outliers.

These PA-indices were analyzed in RStudio using a PERMANOVA test. This statistical test was conducted to determine if there was statistically significant difference between the indices of each rib on each side. PERMANOVA was used because archaeological data does not fit a normal distribution and this test does not require that distribution to work. For example, all of the 3rd right rib PA-indices were compared to each other. They were analyzed in a pairwise manner so that each rib within that analysis could be tested against each other rib to see if there was statistically significant difference. If the p-value was less than .05 then, there was statistically significant difference between the PA-indices of the two ribs, but if the p-value was greater than .05, the opposite was true. For both the left and right ribs, there was no statistically significant difference between the PA-indices when considering any one rib at a time. The lowest p-value was .055 in comparison between the 4th ribs of individual RU-011 and RU-022, RU-022 and RU-009, and RU-027 and RU-009 (See the Appendices). The results of the PERMANOVA tests show that there is not significant difference between the PA-indices of different ribs and individuals.

Figure 12: Posterior Angle Index Right Ribs

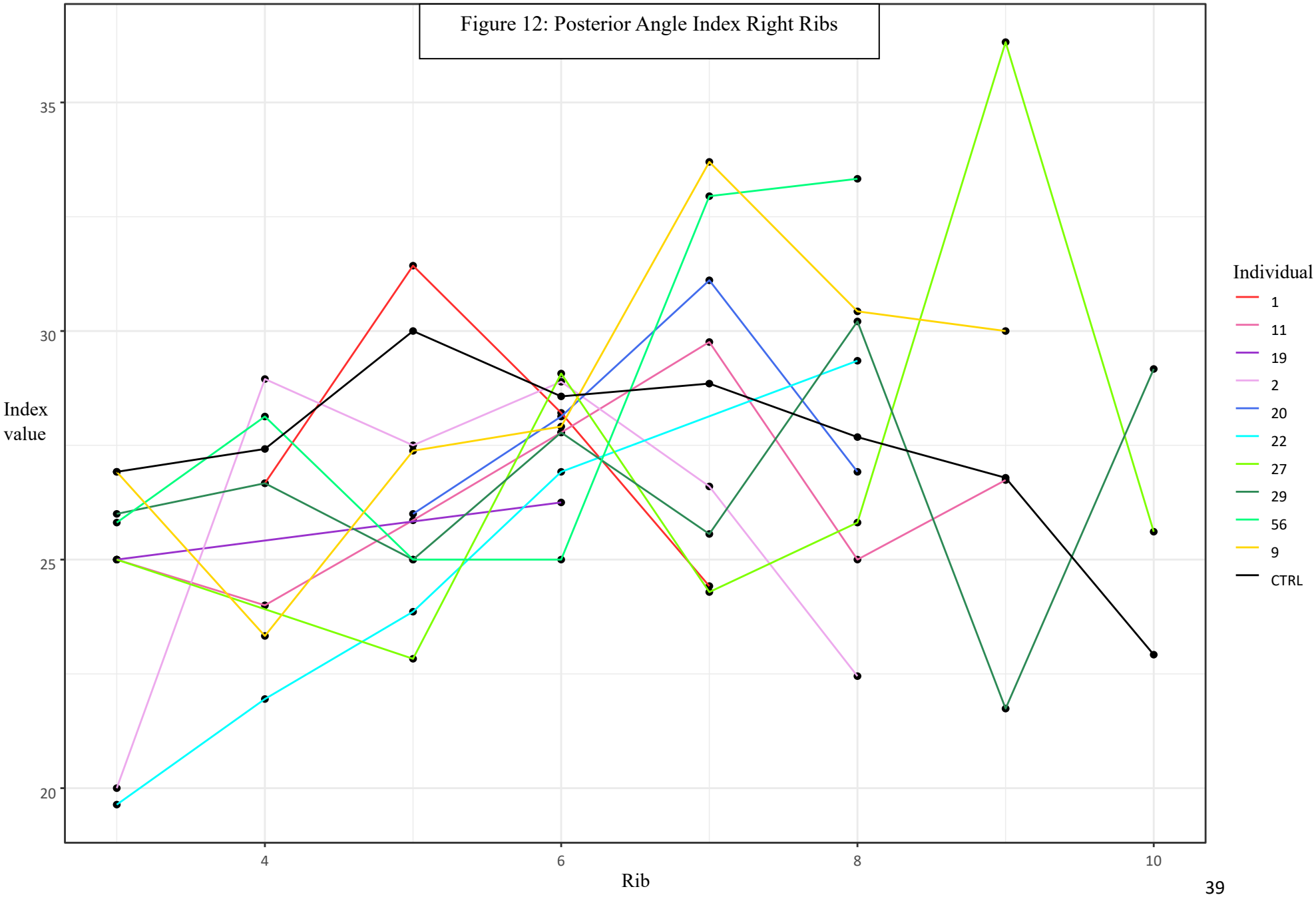
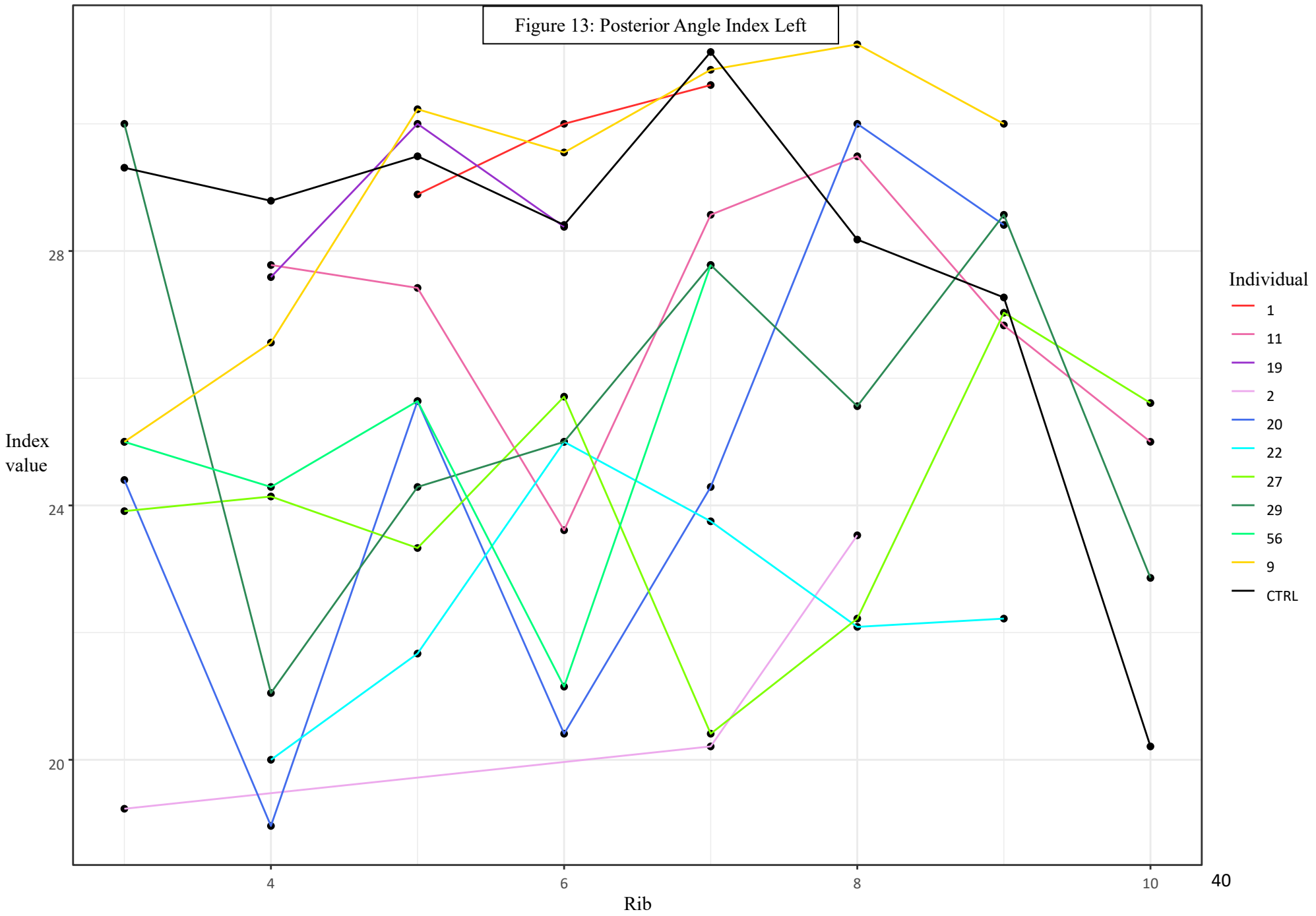


Figure 13: Posterior Angle Index Left



4.3 Total Rib Curvature Index

The next index that was examined was the Total Rib Curvature (TRC) index. This index shows how curved the rib is as a whole. Because this index requires nearly all of the rib to be present for the measurements to be taken, it was more difficult to get this index and not all ribs had the landmarks necessary to measure it. While this index is better for determining the overall curvature of the rib, it was not able to be consistently recorded, leading to the greater importance of the PA-index in this project.

The TRC-index was recorded for every rib where the relevant landmarks were present. It was calculated by dividing the Tuberculo-ventral subtense (TVS) by the Tuberculo-ventral chord (TVC). The TVC is the distance from the midpoint of the articular tubercle to the sternal rib end and the TVS is the distance from the TVC to the lateral-most extant of the shaft of the rib. Then, the indices were plotted and analyzed in RStudio through PERMANOVA tests. Figure 14, which shows the right ribs, shows a trend of a downward "J" curve for the Control. The ribs from the Arch Street Project individuals show a less consistent pattern and specifically individuals RU-002 and RU-020 show a very different pattern.

Following the PERMANOVA tests, there is no significant difference between the indices of the different individuals' ribs. Similar to the PA-index, the right ribs have higher p-values for the PERMANOVA tests while the left ribs show more difference with lower p-values. This is consistent with what is displayed in the TRC-index graphs as well as the PERMANOVA tests for the PA-index.

Figure 14: Total Rib Curvature Right Ribs

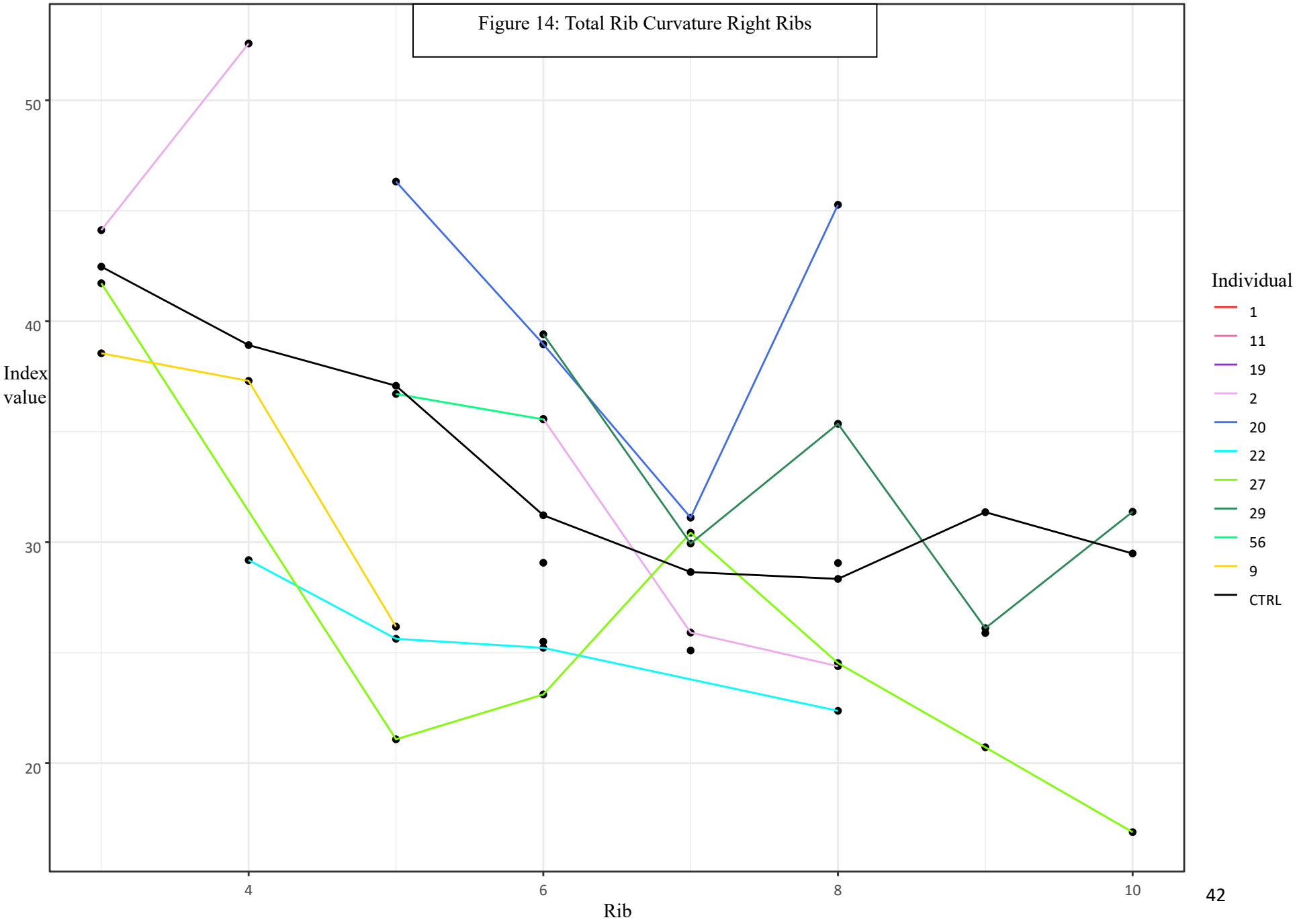
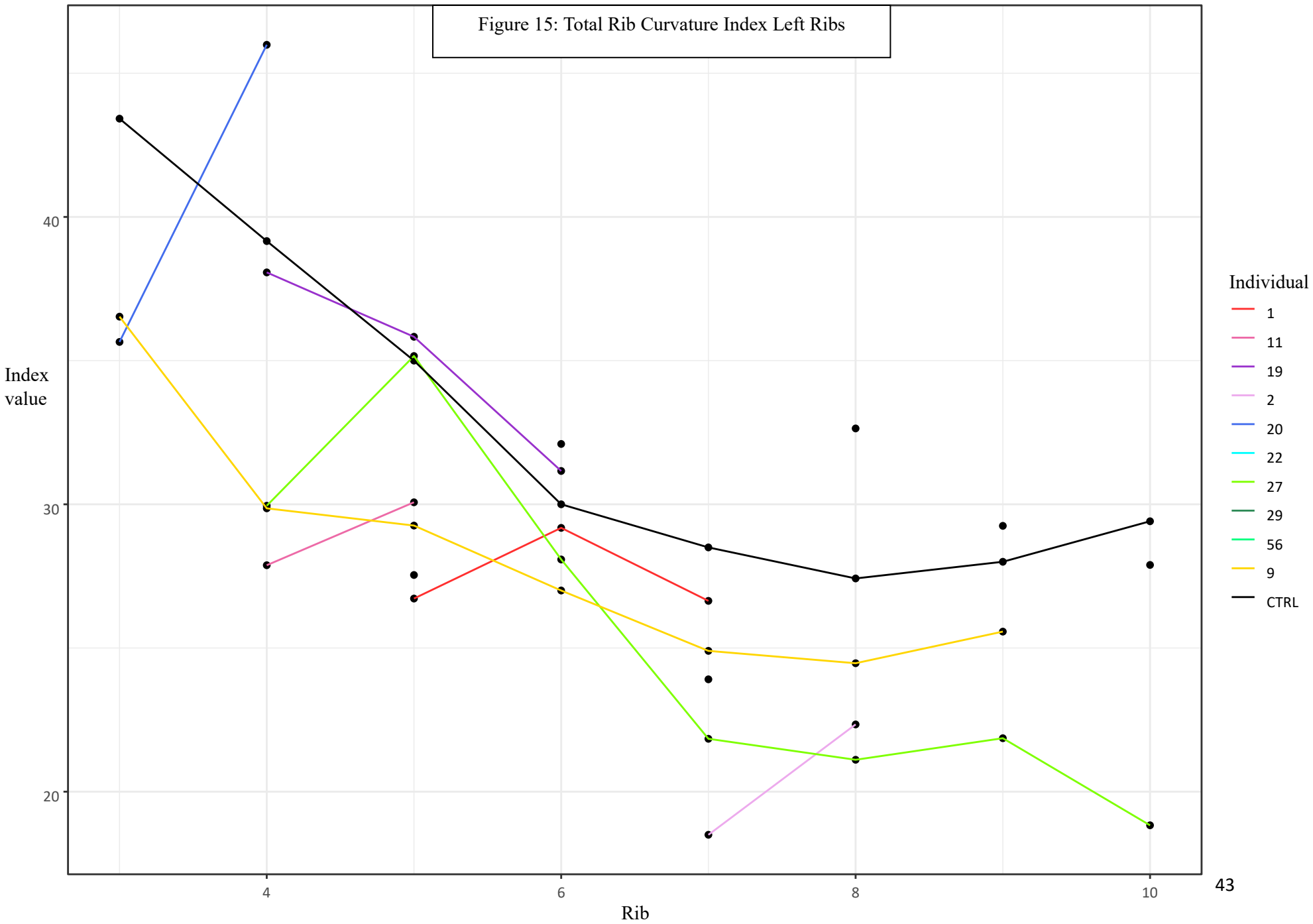


Figure 15: Total Rib Curvature Index Left Ribs



4.4 Respiratory Area

The Respiratory Area (RSP-AREA) calculates the area inside the rib which forms the chest cavity. This is calculated using the following equation developed by Franciscus and Churchill (2002):

$$RSP\text{-}AREA=0.5\pi(0.5*TVC)TVS$$

This equation was applied to every rib where the TVC and the TVS could be determined. The data was entered into RStudio to create graphs for data visualization and to run PERMANOVA tests with pairwise comparison.

The graphs (Figure 16 and Figure 17) show a slight bell curve that is right skewed for the Control. The other individuals do not follow this pattern and instead show large dips in the data in the cases of RU-009 and RU-027 for the left ribs (Figure 17). This suggests a narrowing about halfway down the ribcage, with broader areas above and below. For the right ribs (Figure 16), RU-027 and RU-022 show a similar pattern of a big increase in RSP-AREA followed by a steady decline, suggesting that the broadest area of the rib cage was at a lower point on the body than that of the modern specimen. Since the data for TVC and TVS are incomplete due to the fragmentary nature of archaeological remains, the lines on the RSP-AREA are segmented on the graph making it difficult to create whole picture of the respiratory cavity.

The PERMANOVA tests for the right ribs have a highest p-value of 1, indicating no difference at all, and a low of 0.33 showing that while there are some differences between the RSP-AREA of certain individuals, there is no statistically significant difference. This is not the case for the left ribs. While the high p-value is still 1, the low is 0.045. In order for there to be statistically significant difference between two individuals, the number has to be below 0.05. The difference between the 4^{th} left rib of RU-009 and RU-020 as well as the difference between the 4^{th} left rib of RU-009 and the Control are statistically significant. RU-009 has low p-values for the 4^{th} rib compared to the other individuals except for RU-019 where the p-value is 0.604. This shows that even compared to the other 4^{th} left ribs of the other individuals, RU-009 has either significant difference or a noticeable difference compared to almost every other individual.

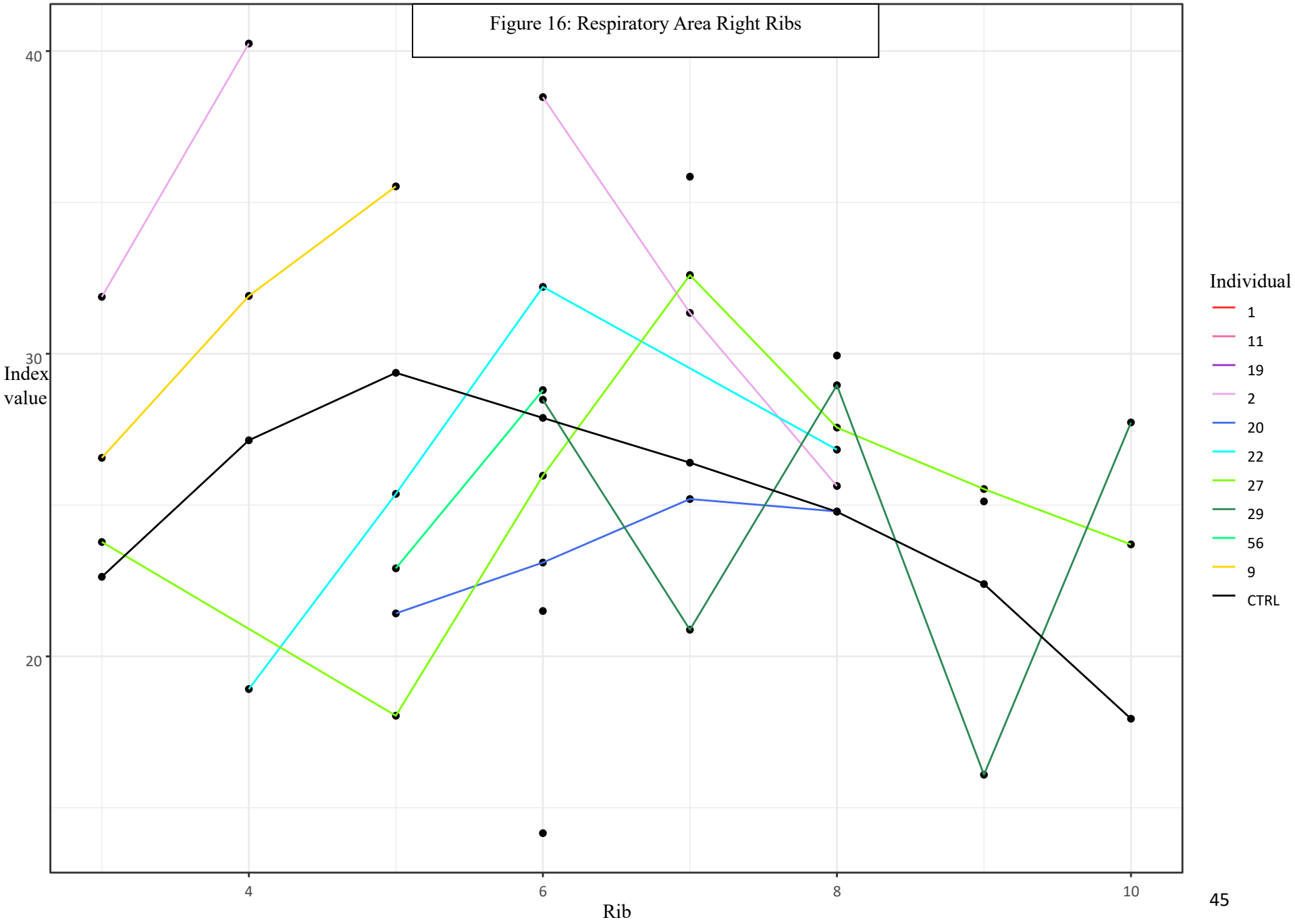
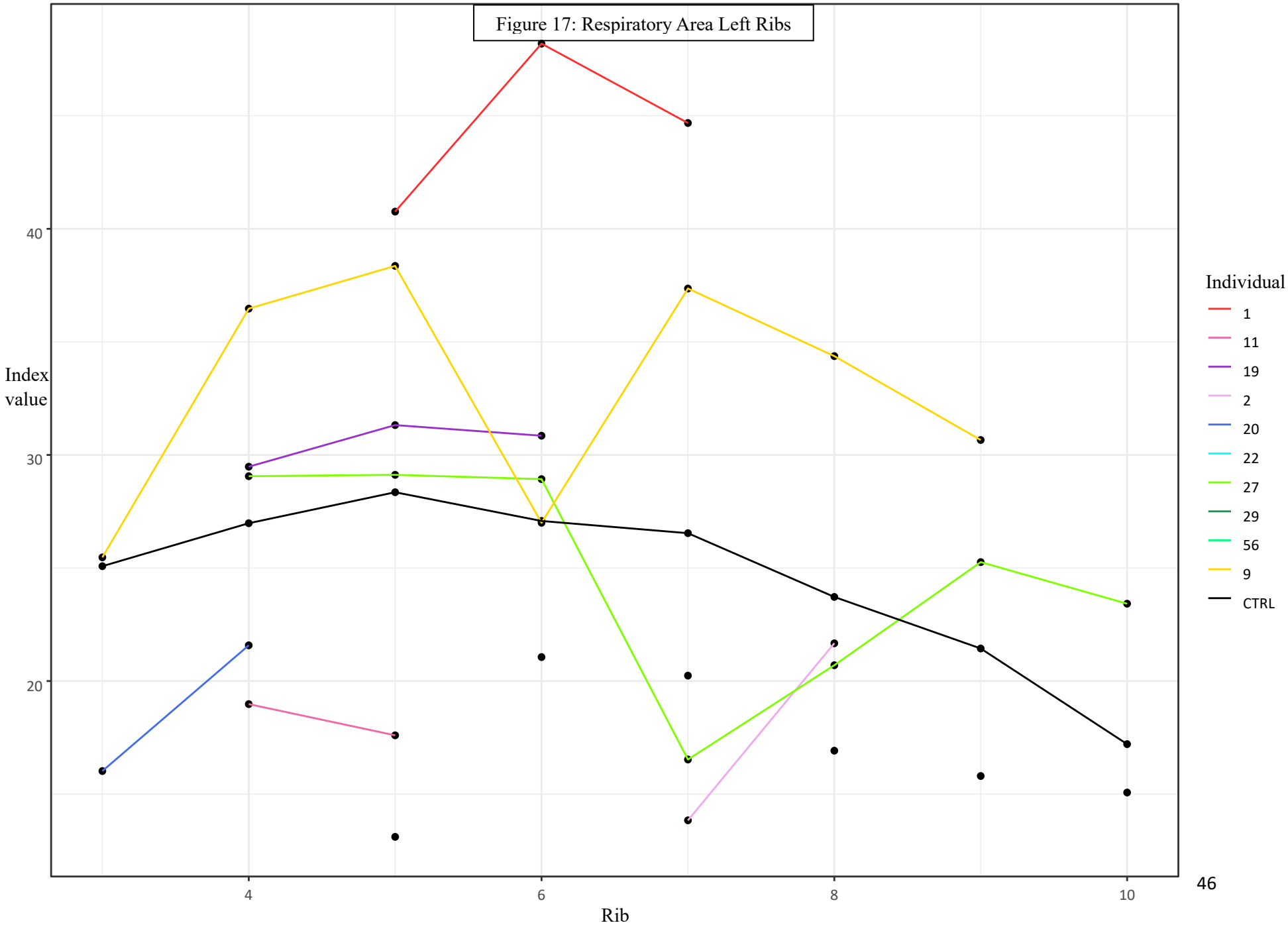


Figure 16: Respiratory Area Right Ribs
40
30
20
Index value
4
6
8
10
Rib
Individual
1
11
19
2
20
22
27
29
56
9
CTRL

Figure 17: Respiratory Area Left Ribs



4.5 Thoracic Vertebral Angle

The thoracic vertebrae make up the central part of the spine and would therefore be the vertebrae that would most likely display any changes due to the pressure of corseting. These are the vertebrae that the ribs articulate with. In her article, Gibson (2015) shows how the deformation of the spinous process (the most posterior part of the vertebrae) on the thoracic vertebrae indicates prolonged corset usage.

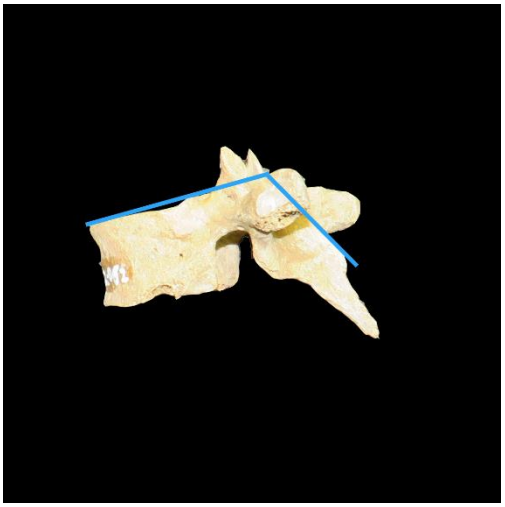


Figure 18 Example of a thoracic vertebra with a more acute angle of the spinous process

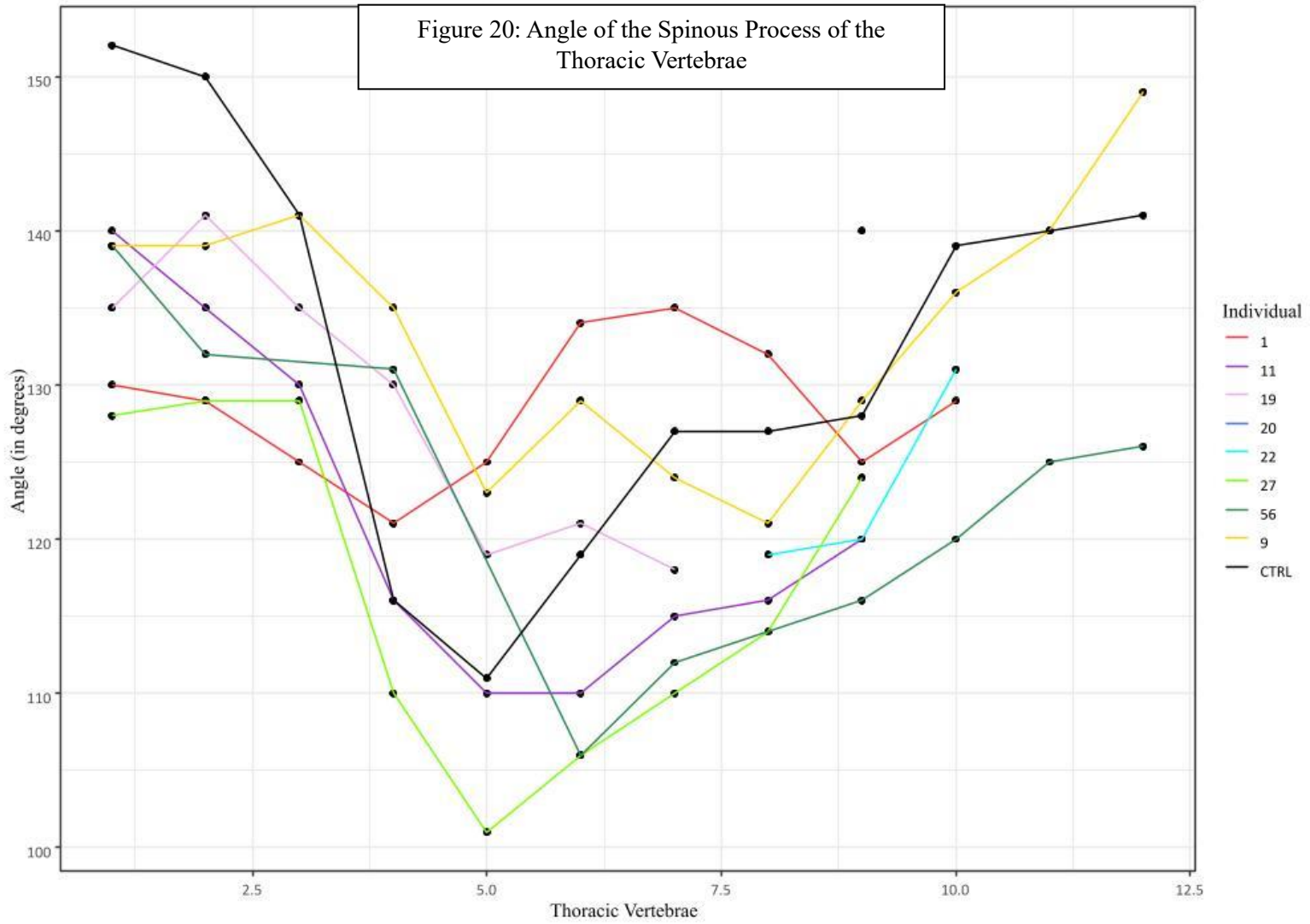
Figure 19 Example of a thoracic vertebra with a more obtuse angle of the spinous process

The control data shows that there is normally a dip in the angle of the spinous process around T4 and it starts increasing around T7. Figure 9 shows this trend and also shows that for many of the individuals from the Arch Street Project, the angle of the spinous process of T1 is much smaller than that of the control. It is also evident that for many of the individuals, the angle of the spinous process is consistently smaller than that of the control. This is true in the case of RU-011, RU-022, RU-027, and RU-056. This smaller angle measurement trend is not seen in all of the individuals though, especially in the case of RU-001 where the data is almost the inverse of the pattern of the rest of the individuals.

4.6 Conclusion

The results for the PA-index and the TRC-index show some differences, but not statistically significant differences. The angle of the spinous process of the thoracic vertebrae, however showed some interesting differences between the control and the archaeological remains. These results will be discussed and analyzed further in the Discussion section.

Figure 20: Angle of the Spinous Process of the Thoracic Vertebrae



Chapter 5: Discussion

5.1 Introduction

This section will discuss the results that were presented in the previous chapter. It will delve in depth into the data gathered over the course of this research project and compare it to the hypothesis presented at the beginning of this thesis that due to the increase in the romanticization of tuberculosis in art and literature at the time, fashion changed to mimic the disease-causing morphological changes to the skeleton in the United States. The data will then be connected to a broader historical context followed by a conclusion and future directions.

5.2 Discussion of Results

5.2.1 PA-index

While some of the results may suggest indication of prolonged corset usage, none of them showed statistically significant differences from the control that would suggest tight-lacing or extreme corset usage. Looking closely at the ribs that Gibson (2015) points out as being the most impacted by long-term corseting (ribs 6-8), one can see more clearly the similarities and differences between the rib measurements and indices. Figure 21 shows the PA-index of the right ribs 6-8 only (for the full graph, see Fig. 12). This graph shows how most of the indices are clustered together for right rib 6 but branch out for right rib 7. However, when conducting the PERMANOVA tests, there was no statistically significant difference. It is also important to note that while it appears as though there is a large gap between the PA-indices, the range is small.

A similar trend can be seen in Figure 22 for the left ribs 6-8. While the full data set in Figure 4 was overwhelming and did not follow a recognizable pattern, when focusing on ribs 6-8 a similar pattern does emerge. The indices for rib 6 are not as close on the left side as on the right, but for rib 7, the range is still relatively small. The PERMANOVA test for the left ribs, while much lower than those of the right, still did not show statistically significant difference between the individuals. This shows that while there is some difference between the right and left sides of the archaeological remains, there is not a significant difference between individuals especially when being compared to the Control. This means that while people may have been corseting, it is not to the extreme that was predicted or what is generally considered in popular media. While there are differences between the indices of each individual, there is not significant enough difference to constitute

extreme corseting or that fits the description of what Gibson (2020) found in the skeletons of individuals who regularly corseted. The PA-index does not show the full curvature of the ribs, but it gives a decent indicator as to whether or not the rib was more curved than what would be expected as ithas an inverse relationship to the TRC-index.

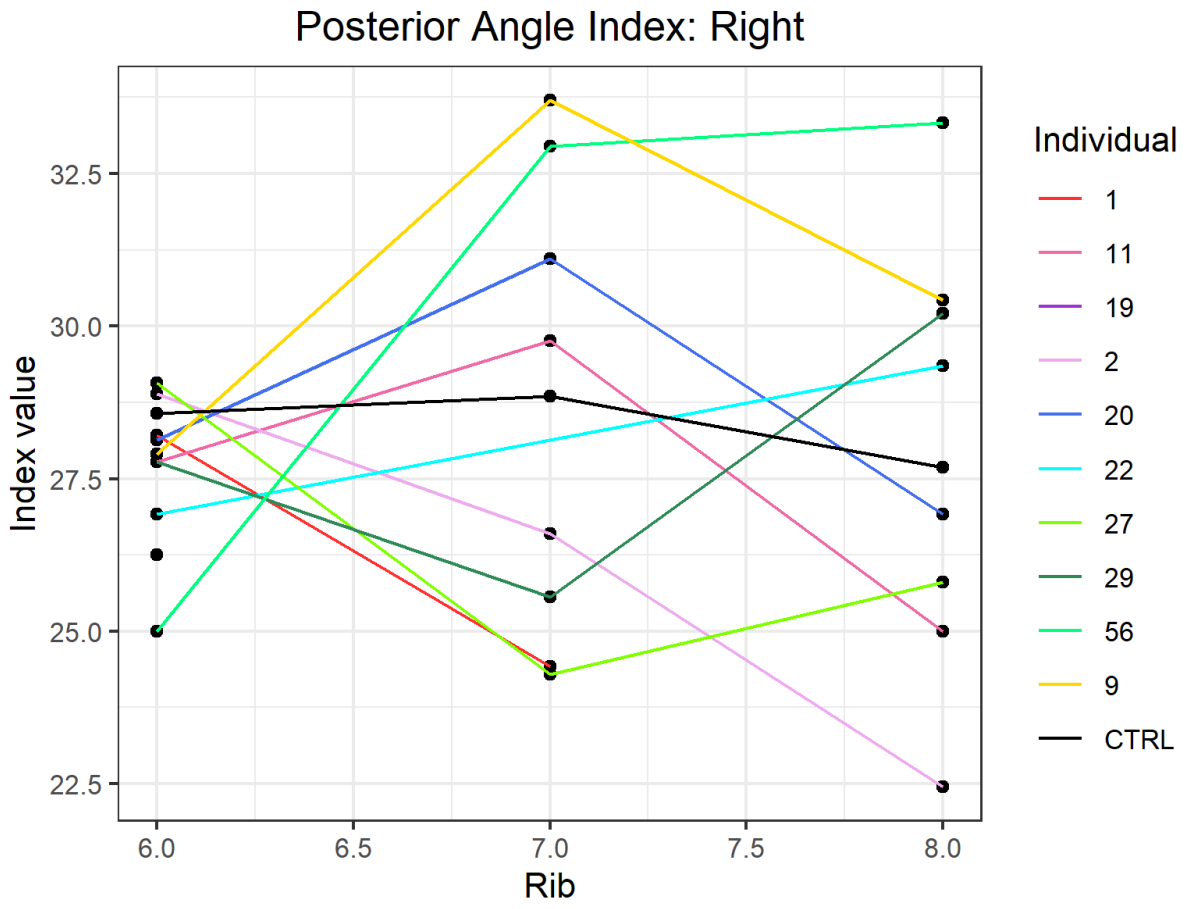


Figure 21: PA-index Right Ribs 6-8

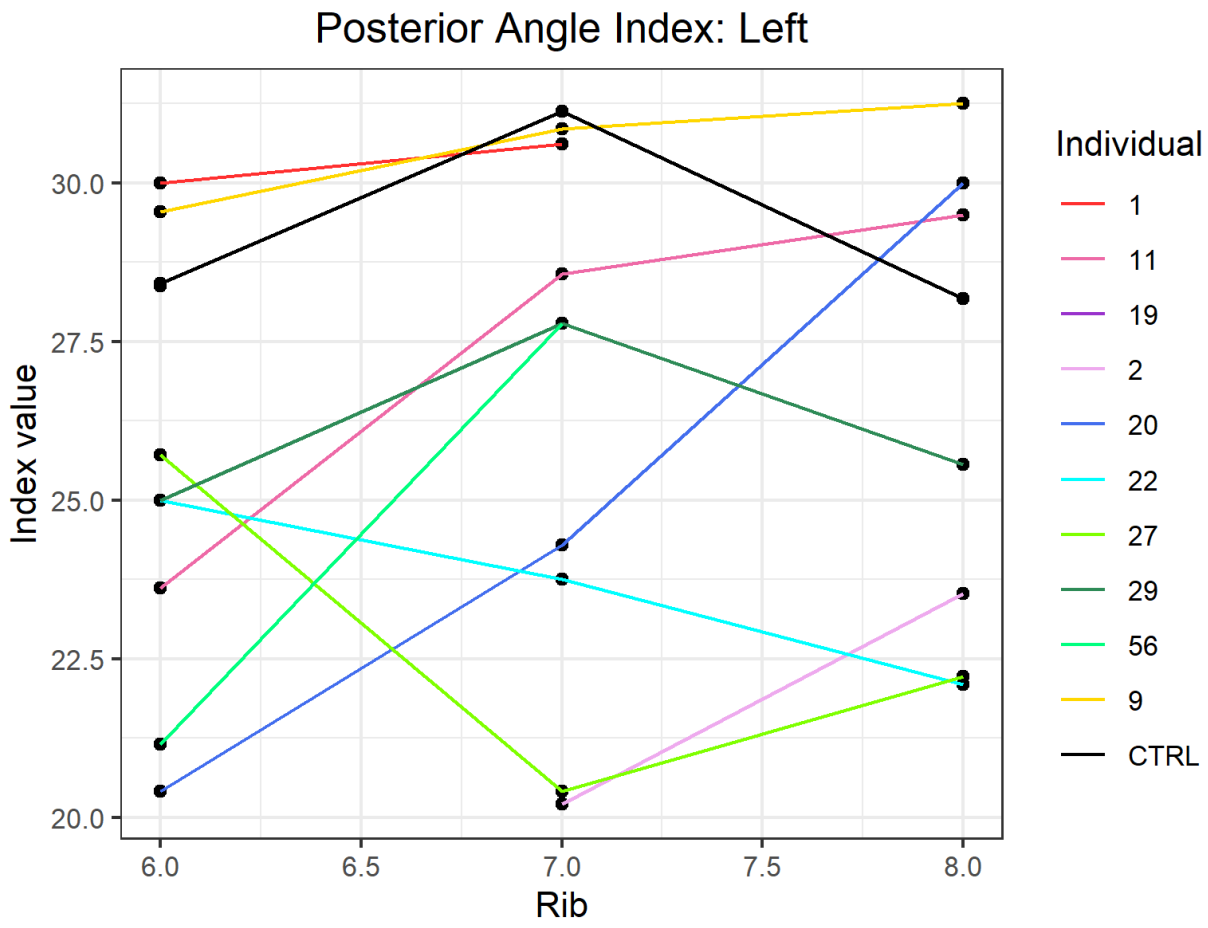
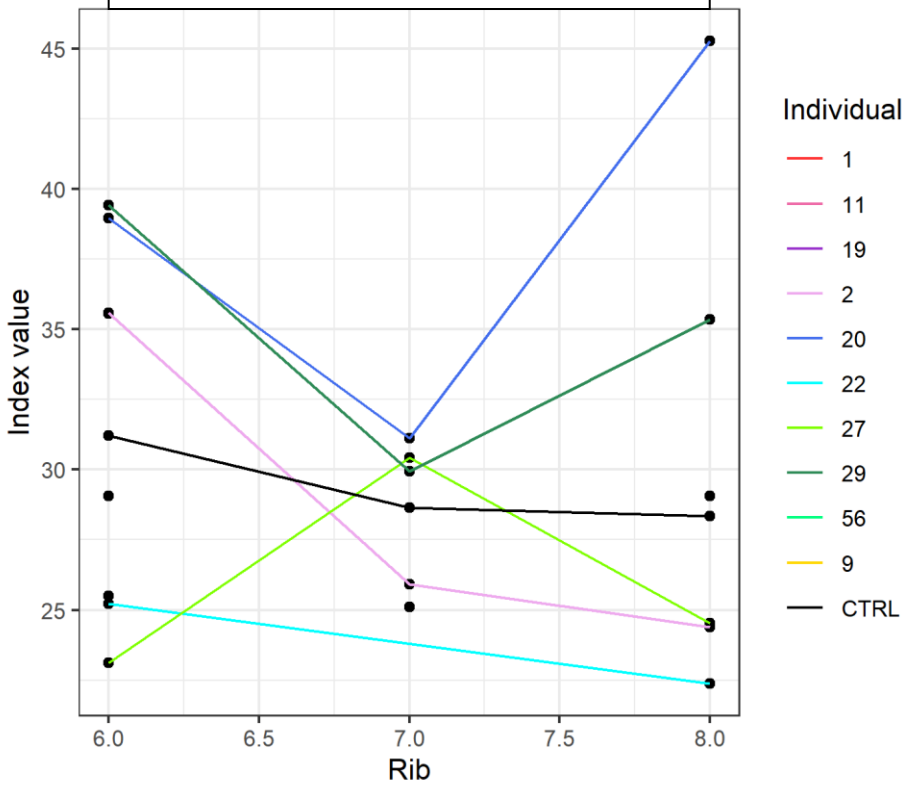


Figure 22: PA-index Left Ribs 6-8

5.2.2 TRC-index

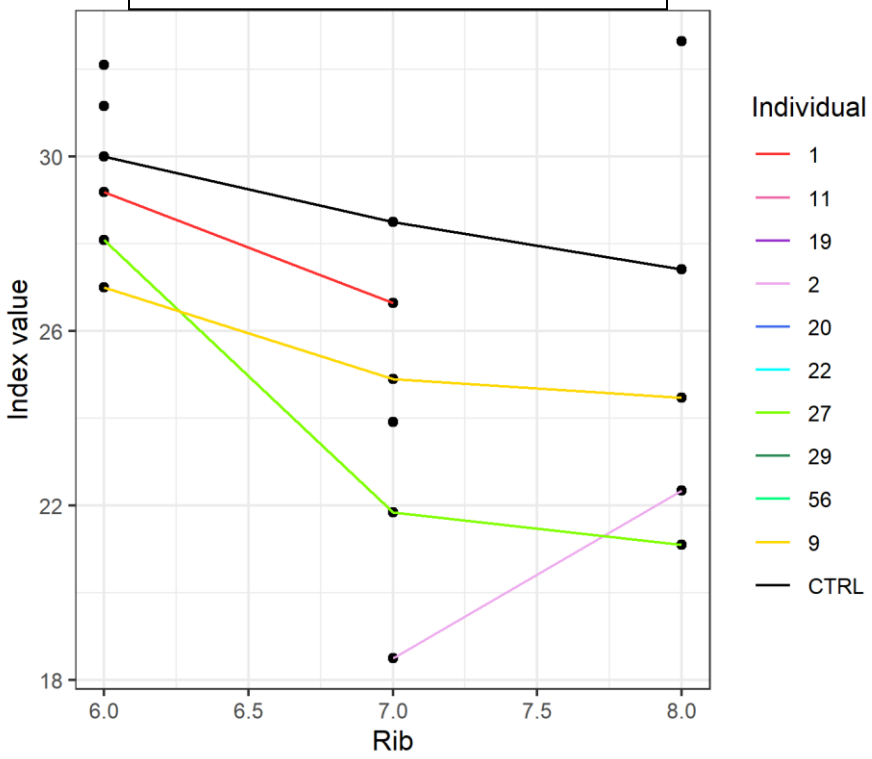
While the PA-index only shows the acuteness of the angle of the rib at the iliocostal line (the area closest to the spine), the TRC-index shows how curved the rib is in total. Objectively, the TRC-index gives a better indication as to whether or not a rib's curvature has been impacted in any way and possibly by corsetry. The issue with relying solely on the TRC-index though is that it is difficult to find complete ribs in the archaeological record. Through taphonomic and excavation processes, ribs tend to fracture leaving incomplete ribs from which to gather data. This is why, while the TRC-index does give a better indication as to the curvature of the whole rib, the PA-index is a good proxy to use when dealing with fragmentary remains. The higher the TRC-index, the more curved the rib is. The TRC-index has an almost inverse relationship with the PA-index, meaning that a high PA-index relates to a lower TRC-index and vice versa. When focusing on ribs 6-8, one can see the relationship between the TRC-index and the PA-index. Figure 23 shows individual RU-020 having a V-shape while this shape is inversed in Figure 21. The same can be seen in the Control, though the V-shape is much less distinct. The V-shape shows that the upper and lower ribs are more curved while the middle ribs form a more oval shape. This inverse relationship makes sense as the TRC-index represents the whole rib while the PA-index is just looking at the head of the rib and the curve at the iliocostal line. A rib that forms a more circular shape, would have a more obtuse angle at the iliocostal line and a more acute angle over all while a more oval-shaped rib would have an acute angle at the iliocostal line with a more obtuse angle of the rib. This relationship can be seen in the graphs and shows how the PA-index can be used as a proxy for the TRC-index when analyzing fragmented archaeological remains.

Figure 23: Total Rib Curvature: Right Ribs 6-8



Similar to the PA-indices, the TRC-indices do not show any statistically significant differences between the historical individuals and the control that would possibly indicate long term corset usage or tightlacing. While there are some ribs of individuals that are more curved than others, mainly RU-002, RU-020, and RU-029, the difference between the individuals is not statistically significant. This could mean that the changes caused by long-term corsetry do not present statistically significant differences in rib morphology or that maybe the changes are still present but not as statistically significant as originally thought or that it falls within normal human variation. Further research on this using a larger sample size needs to be conducted in order to determine if there are any statistically significant differences caused by long-term corsetry and to establish the full range of normal human variation of the ribs.

Figure 24: Total Rib Curvature: Left Ribs 6-8



5.3 Historical Context

Since this project focused on the romanticization of tuberculosis in the United States compared to Europe, the bioarchaeological analysis considered remains from America. Gibson (2020) exemplified that in France and England, one can see how corsetry affected the morphology of the rib cage and Lawlor (2006) shows how European literature was heavily influenced by consumption at the same time. The changes that were expected were not overtly present in the individuals examined for this project. While there was an increase in the importation of Romantic and Gothic literature from Europe to the United States during the late 18th and early 19th centuries, America was also going through intense cultural changes. During the time period analyzed, 1760s-1860s, the United States fought four major wars in its own territory: The French and Indian War (1754-1763), the American Revolutionary War (1775-1783), the War of 1812 (1812-1815), and the American Civil War (1861-1865) (Zinn, 2003).

While the first three wars were fought with other European countries, since they took place on American soil, they may have impacted the Americans living there more directly than the wars

impacted the Europeans. The American Revolutionary War was fought against Great Britain and caused divides within the country due to the treasonous nature of the revolution (Zinn, 2003). After the United States won the war, the Articles of Confederation were drafted and ratified creating the first governmental system, though it proved to be ineffective (Zinn, 2003). While all of these governmental changes were taking place, American culture was becoming distinct from that of Britain. The American Civil War was especially devastating in terms of the evolution of American culture as it tore the country in two (Zinn, 2003). This war took place before the 100th anniversary of the start of the American Revolutionary War and the country was still very new, in terms of the Western notion of a sovereign nation, after the dissolution of the Articles of Confederation in 1789 in favor of the Constitution of the United States of America (Zinn, 2003). It is important to note here that European colonialism violently displaced the indigenous peoples of the Americas and in many cases tried to eradicate their culture. With all of these conflicts happening while the country was being created, it impacted the cultural evolution of the United States. This could explain why the romanticization of tuberculosis did not have as much of an impact in America as in Europe.

While there was an increase in the importation of European literature, examples of American Gothic and Romantic literature that contain portrayals of the romanticization of tuberculosis are not as common as those in Europe. This shows that while the American public enjoyed reading European Gothic and Romantic literature that romanticized tuberculosis, American authors were not greatly influenced by this aspect of European literature at the time (Punter, 1980). While there are examples of romanticization of tuberculosis in Edgar Allan Poe's work, it is difficult to find other American examples (Poe, 1840). On the other hand, Dante Gabriel Rossetti, John Keats, Lord Byron, Percy Bysshe Shelley, and Alphonse de Lamartine produced many works that portrayed a romanticized idea of tuberculosis and had lives that were influenced by the disease. The bohemian movement in Europe influenced the romantic appeal of tuberculosis to writers and artists of the time and it was thought that in order to be an artistic genius, one needed to be sickly and tubercular (Lawlor, 2006). Shelley emphasizes this in the poem "Adonais" that is about Keats' death. This concept was very present in European literature as shown in Chapter 2, but it was not as present in American literature. This also could be a reason as to why the trends that Gibson (2020) saw in both the French and English individuals she examined were not present in the ones examined for this project. Though it is important to note that this project represents a very small sample size and cannot be used to generalize about the broader population. It is very possible that

these changes did occur in other individuals that were not examined for this project. Further research with larger sample sizes needs to be conducted in order to draw more concrete conclusions.

European Gothic and Romantic literature were embodied by the use of corsetry in fashion as a way of conforming to this tubercular ideal of beauty. This was expressed in art as well as literature with works such as those made by the Pre-Raphaelite brotherhood. By viewing the body as material culture, one can analyze it in order to better understand cultural and social practices (Sofaer, 2006). By conducting the research and analysis of the human skeletal remains through this materiality theory, one can better understand how culture and the body are related and how one reflects the other (Sofaer, 2006).

While there was no statistically significant difference between the ribs of the archaeological individuals and the modern specimen, this does not mean that corseting was not present in the United States. Corsetry was prominent in the United States and was used as a staple undergarment, just like in Europe (Selesahanko, 2012). It might be that tight-lacing was not as common in the United States, or it could be possible that the individuals that were looked at for this project did not practice tight-lacing. This could have to do with all of the cultural changes and stagnation that happened in the United States at the time due to the change in government as well as the ongoing conflicts. Figure 25 and Figure 26 are both advertisements from the late 19th century depicting corsets. These two particular advertisements are by American companies trying to sell their corsets to American women. This shows that corsetry was prominent in America and was a necessary undergarment just like it was in Europe.

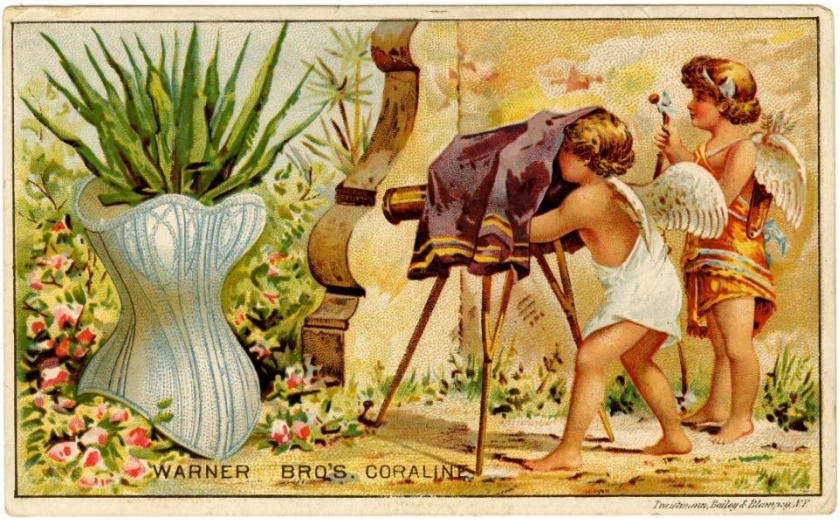


Figure 25 "Warner Bro's Coraline Corset Advertisement." ca. 1890-1900. Smithsonian Institution: Warshaw Collection of Business Americana

While corsetry was a part of daily life in the Western world, the extent to which extreme fashion trends existed is debatable. Not only did the United States go through drastic societal and cultural changes during this 100-year period, but they also fought for major wars in their own territory. This could have impacted the extent to which European culture impacted American culture. It is still evident though, the Romantic and Gothic art were popular in the United States through importation and authors such as Edgar Allan Poe and H.P. Lovecraft (Punter, 1980). While these literary movements were present in the United States, as mentioned before, it is difficult to find many American examples of the romanticization of tuberculosis compared to the plethora of examples in Europe. This could have impacted the ideal of beauty and therefore corset wear during this time period.

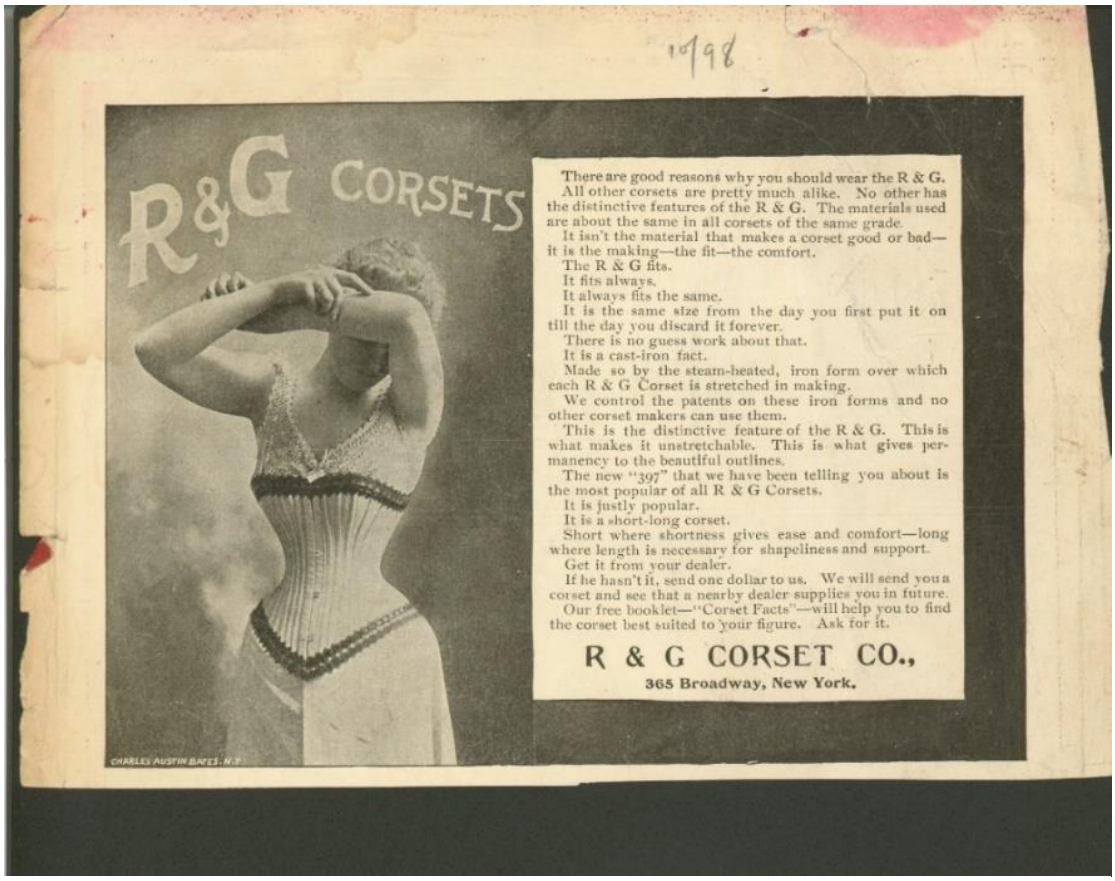


Figure 26 "Woman modeling a corset for R&G Corset Co. of New York City: black and white advertisement." 1889. Smithsonian Institution: Warshaw Collection of Business Americana

5.4 Future Directions

This research project analyzed ten archaeological skeletons as well as a modern specimen to use as a control. Conducting a larger survey with more individuals would be necessary to have a wider sample of data. This would also show if the trends found in this project are present in a larger population study. It would be interesting to conduct a similar, larger scale study in a city that was an international harbor, similar to Philadelphia, where the influence from other cultures, especially European, could be felt more. Similarly, looking at a cemetery that was open though the beginning of the 20th century could provide a good comparison point where the influence of more extreme corseting could possibly be seen since the Arch Street Cemetery closed in 1860.

Another important question to look at further would be why the left ribs do not display any consistent trends or patterns like the right ribs display. The hypothesis presented here is that due to taphonomic or funerary practices at this site, the left portion of the individuals were adversely affected. This could be due to the preparation of the body during funerary rites like how the body was placed into the coffin or how the coffin was lowered into the ground and the angle at which it rested. It could be possible that the individuals were buried on their left side, causing distortion to the left ribs while the right ribs maintained their shape. By lying on their left side, the weight of the individual would have pressed down on the left ribs during interment and throughout the decomposition process, possibly altering the morphology of the ribs. In this study, there was no clear consistent trend in the data from the left ribs compared to that of the right, and further research might benefit from conducting a larger study of individuals from the same site to see if this holds true with more individuals and also between estimated sexes. Since the individuals looked at for this project were either probable females or indeterminate, it would be interesting to see if the same trend, or lack thereof, occurs when looking at estimated male individuals.

5.5 Conclusion

As this section shows, there is no clear indication that the individuals who were examined for this project displayed any signs of tight lacing. This is not to say that they did not wear corsets, only that there was no statistically significant difference between the individuals who were examined and the control. This could be due to the small sample size, human variation, or that the changes due to corset wear are not statistically significant compared to a non-corseting individual. Further

research needs to be done in order to better understand how corseting affects the ribs as well as to better understand the data collected from the left ribs and what caused it. Putting the data into a historical context can show how corsetry was used in the United States as well as what could have impacted the culture, causing different trends than what was found in Europe.

Chapter 6: Conclusion

This project strived to address the question of corsetry in the United States and the impact of tuberculosis on artistic and fashion culture. While in Europe, the influence of tuberculosis on the ideal of beauty is readily seen in the literature of poets and novelists as well as in paintings, this influence is not as prominent in American literature and art. As shown in the literature review, examples of the romanticization of tuberculosis are shown in how so-called beautiful men and women are described in literary works and how it was perpetuated in the fashion trends in Europe at the time. While European literature was imported in large quantities into the United States, since there was a lack of American authored works romanticizing tuberculosis, fashion was used as a proxy by analyzing the morphological changes caused by the fashion of the time (Ringe, 1982).

Corsetry was just one way of achieving the consumptive chic look that was popular during the 19th century, especially in Europe. People, primarily women, were also known to ingest lemon juice to suppress their appetite and wear make-up laced with chemicals to whiten their skin (Dormandy, 2000; Whorton, 2010). These measures that were taken to match the contemporary ideal of beauty could negatively impact the health of the individual, especially in regard to the toxic materials used to whiten the skin (Whorton, 2010). Corsetry during and prior to this period was used as an undergarment to support the bust as well as to redistribute the weight of the petticoats and skirts (Seleshanko, 2012). It was during this time, when tuberculosis gained this romantic attribute, that the corset changed shape to accentuate the waist, creating the classic hour-glass figure that was fashionable during the Victorian era (Seleshanko, 2012). By tight-lacing, women were able to decrease the size of their waists to unnatural proportions, though the women who did this were in the minority (Gibson, 2020).

This research project analyzed the rib morphology of ten archaeological human skeletons from this time period in Philadelphia in order to identify whether there was any statistically significant difference in the rib morphology to suggest corseting, similar to what was seen in Europe by Gibson (2015). By measuring the ribs and using ImageJ to create comparable indices and conducting PERMANOVA tests using RStudio, it was found that there was no statistically significant difference between the archaeological skeletons and the control. As mentioned in the discussion section, this could be due to a variety of reasons such as the difference between

American and European culture and how that culture is embodied in the fashion. It could also be because corset wear does not create statistically significant differences, only subtle ones that would not show as statistically different in the PERMANOVA tests. Another possibility is that since the sample for this project was small, the skeletons that were selected were not ones that would show this difference, but if a larger sample was analyzed, it would be present in some of the individuals. Further research needs to be done in order to learn more about corseting in America compared to Europe as well as to investigate the irregularities in the left rib morphology of the archaeological remains.

7 Appendix

PERMANOVA Pairwise Tables

Each index is shown in a table with each individual listed along the left and top of the table. There are numbers (p-values) at the intersections of each pair. These indicate there is significant difference between the measurements of the individuals when the p-value is less than 0.05.

PA Index Left Rib 3

	1	11	19	2	20	22	27	29	56	9
11	0.143	-	-	-	-	-	-	-	-	-
19	0.381	0.292	-	-	-	-	-	-	-	-
2	0.204	0.061	0.204	-	-	-	-	-	-	-
20	0.165	0.266	0.230	0.292	-	-	-	-	-	-
22	0.061	0.061	0.071	0.381	0.366	-	-	-	-	-
27	0.061	0.086	0.061	0.134	0.840	0.227	-	-	-	-
29	0.129	0.381	0.237	0.093	0.624	0.119	0.364	-	-	-
56	0.119	0.211	0.165	0.165	0.862	0.206	0.659	0.703	-	-
9	0.724	0.211	0.862	0.061	0.086	0.061	0.061	0.129	0.085	-
CTRL	0.435	0.724	0.748	0.086	0.218	0.061	0.093	0.292	0.230	0.574

PA Index Left Rib 4

	1	11	19	2	20	22	27	29	56	9
11	0.147	-	-	-	-	-	-	-	-	-
19	0.384	0.314	-	-	-	-	-	-	-	-
2	0.198	0.073	0.198	-	-	-	-	-	-	-
20	0.155	0.257	0.240	0.265	-	-	-	-	-	-
22	0.085	0.055	0.085	0.364	0.364	-	-	-	-	-
27	0.069	0.085	0.073	0.132	0.836	0.240	-	-	-	-
29	0.147	0.421	0.240	0.110	0.605	0.113	0.364	-	-	-
56	0.110	0.198	0.187	0.176	0.850	0.198	0.678	0.706	-	-
9	0.734	0.198	0.850	0.073	0.113	0.055	0.055	0.110	0.085	-
CTRL	0.474	0.706	0.734	0.073	0.215	0.073	0.086	0.297	0.202	0.605

PA Index Left Rib 5

	1	11	19	2	20	22	27	29	56	9
11	0.134	-	-	-	-	-	-	-	-	-
19	0.384	0.305	-	-	-	-	-	-	-	-
2	0.196	0.076	0.196	-	-	-	-	-	-	-
20	0.158	0.258	0.238	0.287	-	-	-	-	-	-
22	0.080	0.076	0.080	0.361	0.361	-	-	-	-	-
27	0.076	0.087	0.076	0.158	0.825	0.248	-	-	-	-
29	0.134	0.396	0.239	0.092	0.617	0.134	0.361	-	-	-
56	0.122	0.209	0.176	0.165	0.860	0.196	0.665	0.719	-	-
9	0.741	0.209	0.860	0.076	0.092	0.076	0.076	0.093	0.080	-
CTRL	0.428	0.702	0.799	0.094	0.232	0.076	0.092	0.305	0.235	0.617

PA Index Left Rib 6

	1	11	19	2	20	22	27	29	56	9
11	0.155	-	-	-	-	-	-	-	-	-
19	0.393	0.334	-	-	-	-	-	-	-	-
2	0.204	0.055	0.204	-	-	-	-	-	-	-
20	0.194	0.257	0.251	0.284	-	-	-	-	-	-
22	0.090	0.055	0.082	0.393	0.393	-	-	-	-	-
27	0.082	0.092	0.082	0.128	0.829	0.257	-	-	-	-
29	0.128	0.408	0.251	0.113	0.634	0.128	0.386	-	-	-
56	0.113	0.218	0.194	0.184	0.843	0.204	0.676	0.691	-	-
9	0.731	0.218	0.839	0.082	0.113	0.055	0.055	0.113	0.082	-
CTRL	0.457	0.719	0.759	0.102	0.230	0.082	0.113	0.305	0.220	0.634

PA Index Left Rib 7

	1	11	19	2	20	22	27	29	56	9
11	0.143	-	-	-	-	-	-	-	-	-
19	0.384	0.313	-	-	-	-	-	-	-	-
2	0.201	0.063	0.201	-	-	-	-	-	-	-
20	0.143	0.272	0.267	0.272	-	-	-	-	-	-
22	0.082	0.063	0.082	0.375	0.358	-	-	-	-	-
27	0.063	0.086	0.082	0.139	0.843	0.249	-	-	-	-
29	0.124	0.418	0.249	0.110	0.630	0.116	0.340	-	-	-
56	0.116	0.213	0.154	0.158	0.865	0.213	0.651	0.707	-	-
9	0.748	0.201	0.863	0.063	0.086	0.063	0.063	0.124	0.086	-
CTRL	0.435	0.744	0.759	0.086	0.213	0.063	0.103	0.308	0.201	0.630

PA Index Left Rib 8

	1	11	19	2	20	22	27	29	56	9
11	0.141	-	-	-	-	-	-	-	-	-
19	0.384	0.322	-	-	-	-	-	-	-	-
2	0.190	0.073	0.190	-	-	-	-	-	-	-
20	0.165	0.252	0.252	0.275	-	-	-	-	-	-
22	0.073	0.073	0.073	0.372	0.372	-	-	-	-	-
27	0.073	0.089	0.082	0.131	0.804	0.252	-	-	-	-
29	0.131	0.386	0.252	0.113	0.623	0.116	0.358	-	-	-
56	0.104	0.200	0.169	0.141	0.856	0.190	0.650	0.711	-	-
9	0.762	0.190	0.856	0.073	0.089	0.055	0.055	0.089	0.077	-
CTRL	0.449	0.711	0.762	0.082	0.209	0.073	0.089	0.305	0.252	0.575

PA Index Left Rib 9

	1	11	19	2	20	22	27	29	56	9
11	0.152	-	-	-	-	-	-	-	-	-
19	0.391	0.306	-	-	-	-	-	-	-	-
2	0.204	0.073	0.204	-	-	-	-	-	-	-
20	0.156	0.270	0.249	0.270	-	-	-	-	-	-
22	0.080	0.073	0.073	0.389	0.391	-	-	-	-	-
27	0.073	0.096	0.073	0.131	0.848	0.281	-	-	-	-
29	0.131	0.410	0.233	0.113	0.642	0.113	0.360	-	-	-
56	0.116	0.225	0.165	0.156	0.866	0.220	0.670	0.704	-	-
9	0.756	0.216	0.866	0.073	0.113	0.073	0.073	0.113	0.077	-
CTRL	0.462	0.704	0.756	0.102	0.225	0.073	0.102	0.305	0.233	0.621

PA Index Left Rib 10

	1	11	19	2	20	22	27	29	56	9
11	0.147	-	-	-	-	-	-	-	-	-
19	0.384	0.305	-	-	-	-	-	-	-	-
2	0.195	0.064	0.195	-	-	-	-	-	-	-
20	0.148	0.263	0.252	0.263	-	-	-	-	-	-
22	0.082	0.064	0.073	0.355	0.355	-	-	-	-	-
27	0.073	0.090	0.085	0.122	0.821	0.263	-	-	-	-
29	0.124	0.399	0.252	0.119	0.620	0.119	0.355	-	-	-
56	0.126	0.203	0.163	0.185	0.838	0.195	0.658	0.713	-	-
9	0.720	0.188	0.838	0.064	0.090	0.064	0.064	0.119	0.073	-
CTRL	0.435	0.713	0.765	0.092	0.211	0.064	0.090	0.310	0.211	0.606

PA Index Right Rib 3

	1	11	19	2	20	22	27	29	56	9
11	0.87	-	-	-	-	-	-	-	-	-
19	0.89	0.89	-	-	-	-	-	-	-	-
2	0.88	0.89	0.94	-	-	-	-	-	-	-
20	0.94	0.87	0.87	0.87	-	-	-	-	-	-
22	0.87	0.87	0.89	0.89	0.87	-	-	-	-	-
27	0.89	0.94	0.94	0.89	0.89	0.87	-	-	-	-
29	0.89	0.94	0.89	0.89	0.87	0.87	0.94	-	-	-
56	0.94	0.87	0.89	0.87	0.94	0.87	0.89	0.87	-	-
9	0.89	0.87	0.87	0.87	0.94	0.87	0.89	0.87	0.94	-
CTRL	0.94	0.87	0.87	0.87	0.89	0.87	0.89	0.89	0.89	0.89

PA Index Right Rib 4

	1	11	19	2	20	22	27	29	56	9
11	0.87	-	-	-	-	-	-	-	-	-
19	0.91	0.93	-	-	-	-	-	-	-	-
2	0.89	0.93	0.93	-	-	-	-	-	-	-
20	0.93	0.87	0.87	0.87	-	-	-	-	-	-
22	0.87	0.87	0.93	0.93	0.87	-	-	-	-	-
27	0.93	0.93	0.93	0.93	0.93	0.87	-	-	-	-
29	0.91	0.93	0.93	0.93	0.87	0.87	0.93	-	-	-
56	0.93	0.87	0.91	0.87	0.93	0.87	0.92	0.87	-	-
9	0.93	0.87	0.87	0.87	0.93	0.87	0.89	0.87	0.94	-
CTRL	0.93	0.87	0.87	0.87	0.93	0.87	0.93	0.91	0.93	0.91

PA Index Right Rib 5

	1	11	19	2	20	22	27	29	56	9
11	0.90	-	-	-	-	-	-	-	-	-
19	0.90	0.92	-	-	-	-	-	-	-	-
2	0.90	0.92	0.94	-	-	-	-	-	-	-
20	0.94	0.88	0.88	0.88	-	-	-	-	-	-
22	0.88	0.88	0.92	0.92	0.88	-	-	-	-	-
27	0.92	0.94	0.94	0.92	0.92	0.88	-	-	-	-
29	0.92	0.94	0.92	0.92	0.88	0.88	0.94	-	-	-
56	0.94	0.88	0.90	0.88	0.94	0.88	0.92	0.88	-	-
9	0.92	0.88	0.89	0.88	0.94	0.88	0.90	0.88	0.94	-
CTRL	0.94	0.88	0.88	0.88	0.92	0.88	0.92	0.90	0.92	0.90

PA Index Right Rib 6

	1	11	19	2	20	22	27	29	56	9
11	0.91	-	-	-	-	-	-	-	-	-
19	0.92	0.92	-	-	-	-	-	-	-	-
2	0.91	0.92	0.95	-	-	-	-	-	-	-
20	0.95	0.88	0.88	0.88	-	-	-	-	-	-
22	0.88	0.88	0.92	0.92	0.88	-	-	-	-	-
27	0.92	0.95	0.94	0.92	0.92	0.88	-	-	-	-
29	0.92	0.95	0.94	0.92	0.88	0.88	0.95	-	-	-
56	0.94	0.88	0.92	0.88	0.95	0.88	0.92	0.88	-	-
9	0.92	0.88	0.88	0.88	0.95	0.88	0.91	0.88	0.95	-
CTRL	0.95	0.88	0.88	0.88	0.92	0.88	0.92	0.91	0.92	0.92

PA Index Right Rib 7

	1	11	19	2	20	22	27	29	56	9
11	0.86	-	-	-	-	-	-	-	-	-
19	0.92	0.93	-	-	-	-	-	-	-	-
2	0.92	0.93	0.94	-	-	-	-	-	-	-
20	0.94	0.86	0.86	0.86	-	-	-	-	-	-
22	0.86	0.86	0.93	0.93	0.86	-	-	-	-	-
27	0.93	0.94	0.94	0.93	0.93	0.86	-	-	-	-
29	0.93	0.94	0.93	0.93	0.86	0.86	0.94	-	-	-
56	0.94	0.86	0.92	0.86	0.94	0.86	0.92	0.86	-	-
9	0.93	0.86	0.86	0.86	0.94	0.86	0.92	0.86	0.94	-
CTRL	0.94	0.86	0.86	0.86	0.93	0.86	0.93	0.92	0.93	0.92

PA Index Right Rib 8

	1	11	19	2	20	22	27	29	56	9
11	0.85	-	-	-	-	-	-	-	-	-
19	0.92	0.93	-	-	-	-	-	-	-	-
2	0.92	0.93	0.95	-	-	-	-	-	-	-
20	0.95	0.85	0.85	0.85	-	-	-	-	-	-
22	0.85	0.85	0.93	0.93	0.85	-	-	-	-	-
27	0.93	0.95	0.93	0.93	0.93	0.85	-	-	-	-
29	0.93	0.95	0.93	0.93	0.85	0.85	0.95	-	-	-
56	0.95	0.85	0.92	0.85	0.95	0.85	0.93	0.85	-	-
9	0.93	0.85	0.85	0.85	0.95	0.85	0.92	0.85	0.95	-
CTRL	0.95	0.85	0.85	0.85	0.93	0.85	0.93	0.92	0.93	0.92

PA Index Right Rib 9

	1	11	19	2	20	22	27	29	56	9
11	0.90	-	-	-	-	-	-	-	-	-
19	0.90	0.93	-	-	-	-	-	-	-	-
2	0.90	0.93	0.94	-	-	-	-	-	-	-
20	0.94	0.88	0.88	0.88	-	-	-	-	-	-
22	0.88	0.88	0.93	0.93	0.88	-	-	-	-	-
27	0.93	0.94	0.94	0.93	0.93	0.88	-	-	-	-
29	0.92	0.94	0.93	0.93	0.88	0.88	0.94	-	-	-
56	0.94	0.88	0.90	0.88	0.94	0.88	0.90	0.88	-	-
9	0.93	0.88	0.88	0.88	0.94	0.88	0.90	0.88	0.94	-
CTRL	0.94	0.88	0.88	0.88	0.93	0.88	0.93	0.90	0.93	0.90

PA Index Right Rib 10

	1	11	19	2	20	22	27	29	56	9
11	0.89	-	-	-	-	-	-	-	-	-
19	0.91	0.91	-	-	-	-	-	-	-	-
2	0.91	0.91	0.94	-	-	-	-	-	-	-
20	0.94	0.86	0.86	0.86	-	-	-	-	-	-
22	0.86	0.86	0.91	0.91	0.86	-	-	-	-	-
27	0.91	0.94	0.94	0.91	0.91	0.86	-	-	-	-
29	0.91	0.94	0.91	0.91	0.86	0.86	0.94	-	-	-
56	0.94	0.86	0.91	0.86	0.94	0.86	0.91	0.86	-	-
9	0.91	0.86	0.86	0.86	0.94	0.86	0.91	0.86	0.94	-
CTRL	0.94	0.86	0.86	0.86	0.91	0.86	0.91	0.91	0.91	0.91

TRC Index Right Rib 3

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.93	0.86	-	-	-	-	-	-	-
20	0.53	0.53	0.86	-	-	-	-	-	-
22	0.86	1.00	0.46	0.31	-	-	-	-	-
27	0.90	0.95	0.43	0.31	0.90	-	-	-	-
29	0.86	0.69	0.86	0.46	0.31	0.43	-	-	-
56	0.90	0.55	0.93	0.53	0.43	0.43	0.86	-	-
9	1.00	0.86	0.82	0.43	0.53	0.53	0.86	0.69	-
CTRL	0.86	0.53	0.86	0.43	0.31	0.31	0.90	0.97	0.69

TRC Index Right Rib 4

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.94	0.90	-	-	-	-	-	-	-
20	0.55	0.55	0.90	-	-	-	-	-	-
22	0.90	1.00	0.46	0.29	-	-	-	-	-
27	0.90	0.95	0.43	0.29	0.90	-	-	-	-
29	0.90	0.70	0.90	0.46	0.29	0.44	-	-	-
56	0.90	0.55	0.95	0.55	0.43	0.46	0.90	-	-
9	1.00	0.90	0.84	0.43	0.55	0.55	0.90	0.72	-
CTRL	0.90	0.55	0.90	0.43	0.29	0.29	0.90	0.98	0.72

TRC Index Right Rib 5

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.93	0.86	-	-	-	-	-	-	-
20	0.52	0.52	0.85	-	-	-	-	-	-
22	0.86	1.00	0.44	0.38	-	-	-	-	-
27	0.89	0.93	0.38	0.38	0.91	-	-	-	-
29	0.86	0.70	0.86	0.43	0.38	0.38	-	-	-
56	0.89	0.55	0.93	0.52	0.38	0.43	0.86	-	-
9	1.00	0.86	0.80	0.38	0.55	0.52	0.86	0.71	-
CTRL	0.86	0.55	0.86	0.38	0.38	0.38	0.89	0.96	0.71

TRC Index Right Rib 6

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.94	0.87	-	-	-	-	-	-	-
20	0.52	0.52	0.81	-	-	-	-	-	-
22	0.87	1.00	0.44	0.32	-	-	-	-	-
27	0.90	0.95	0.41	0.32	0.90	-	-	-	-
29	0.87	0.70	0.87	0.41	0.36	0.41	-	-	-
56	0.90	0.57	0.95	0.52	0.41	0.41	0.87	-	-
9	1.00	0.87	0.78	0.41	0.57	0.53	0.87	0.74	-
CTRL	0.87	0.52	0.87	0.41	0.32	0.32	0.90	0.95	0.70

TRC Index Right Rib 7

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.93	0.87	-	-	-	-	-	-	-
20	0.53	0.53	0.78	-	-	-	-	-	-
22	0.87	1.00	0.47	0.40	-	-	-	-	-
27	0.89	0.94	0.41	0.40	0.89	-	-	-	-
29	0.87	0.68	0.87	0.45	0.41	0.41	-	-	-
56	0.89	0.55	0.93	0.53	0.41	0.44	0.87	-	-
9	1.00	0.87	0.78	0.41	0.55	0.53	0.87	0.68	-
CTRL	0.87	0.53	0.87	0.41	0.40	0.40	0.89	0.96	0.68

TRC Index Right Rib 8

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.94	0.89	-	-	-	-	-	-	-
20	0.54	0.54	0.87	-	-	-	-	-	-
22	0.89	1.00	0.46	0.33	-	-	-	-	-
27	0.91	0.94	0.42	0.28	0.91	-	-	-	-
29	0.89	0.70	0.89	0.43	0.42	0.42	-	-	-
56	0.91	0.58	0.94	0.54	0.42	0.43	0.89	-	-
9	1.00	0.89	0.80	0.42	0.58	0.54	0.89	0.73	-
CTRL	0.89	0.54	0.89	0.42	0.28	0.28	0.91	0.95	0.73

TRC Index Right Rib 9

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.94	0.88	-	-	-	-	-	-	-
20	0.56	0.56	0.86	-	-	-	-	-	-
22	0.88	1.00	0.44	0.28	-	-	-	-	-
27	0.88	0.94	0.36	0.28	0.88	-	-	-	-
29	0.88	0.67	0.88	0.36	0.28	0.36	-	-	-
56	0.88	0.58	0.94	0.56	0.36	0.36	0.88	-	-
9	1.00	0.88	0.86	0.36	0.59	0.56	0.88	0.67	-
CTRL	0.88	0.56	0.88	0.36	0.28	0.28	0.88	0.98	0.67

TRC Index Right Rib 10

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.94	0.87	-	-	-	-	-	-	-
20	0.54	0.54	0.85	-	-	-	-	-	-
22	0.87	1.00	0.54	0.29	-	-	-	-	-
27	0.87	0.95	0.36	0.29	0.87	-	-	-	-
29	0.87	0.70	0.87	0.36	0.29	0.36	-	-	-
56	0.87	0.55	0.95	0.54	0.36	0.42	0.87	-	-
9	1.00	0.87	0.75	0.36	0.55	0.54	0.87	0.72	-
CTRL	0.87	0.55	0.87	0.36	0.29	0.29	0.87	0.98	0.73

TRC Index Left Rib 3

	1	11	19	2	20	27	29	56	9
11	0.54	-	-	-	-	-	-	-	-
19	0.30	0.30	-	-	-	-	-	-	-
2	0.30	0.30	0.30	-	-	-	-	-	-
20	0.30	0.30	0.88	0.30	-	-	-	-	-
27	0.54	0.47	0.28	0.54	0.28	-	-	-	-
29	0.59	0.88	0.44	0.48	0.33	0.54	-	-	-
56	0.44	0.44	0.44	0.77	0.44	1.00	0.48	-	-
9	0.88	0.88	0.28	0.28	0.28	0.44	0.94	0.44	-
CTRL	0.33	0.47	0.55	0.28	0.47	0.28	0.52	0.44	0.30

TRC Index Left Rib 4

	1	11	19	2	20	27	29	56	9
11	0.53	-	-	-	-	-	-	-	-
19	0.30	0.30	-	-	-	-	-	-	-
2	0.30	0.30	0.30	-	-	-	-	-	-
20	0.30	0.30	0.88	0.30	-	-	-	-	-
27	0.56	0.47	0.30	0.53	0.28	-	-	-	-
29	0.59	0.88	0.43	0.48	0.35	0.53	-	-	-
56	0.43	0.43	0.43	0.77	0.43	1.00	0.48	-	-
9	0.89	0.88	0.30	0.30	0.28	0.43	0.93	0.43	-
CTRL	0.37	0.47	0.53	0.28	0.47	0.28	0.52	0.43	0.35

TRC Index Left Rib 5

	1	11	19	2	20	27	29	56	9
11	0.53	-	-	-	-	-	-	-	-
19	0.30	0.30	-	-	-	-	-	-	-
2	0.30	0.30	0.30	-	-	-	-	-	-
20	0.30	0.30	0.89	0.30	-	-	-	-	-
27	0.55	0.47	0.25	0.53	0.25	-	-	-	-
29	0.59	0.88	0.43	0.48	0.35	0.53	-	-	-
56	0.43	0.43	0.43	0.77	0.43	1.00	0.48	-	-
9	0.92	0.88	0.25	0.25	0.25	0.43	0.93	0.43	-
CTRL	0.36	0.46	0.55	0.25	0.47	0.25	0.49	0.43	0.31

TRC Index Left Rib 6

	1	11	19	2	20	27	29	56	9
11	0.53	-	-	-	-	-	-	-	-
19	0.30	0.30	-	-	-	-	-	-	-
2	0.30	0.30	0.30	-	-	-	-	-	-
20	0.30	0.30	0.88	0.30	-	-	-	-	-
27	0.57	0.46	0.30	0.53	0.27	-	-	-	-
29	0.59	0.88	0.43	0.48	0.33	0.53	-	-	-
56	0.43	0.43	0.43	0.77	0.43	1.00	0.48	-	-
9	0.92	0.88	0.30	0.27	0.27	0.43	0.95	0.43	-
CTRL	0.33	0.46	0.55	0.27	0.46	0.27	0.50	0.43	0.33

TRC Index Left Rib 7

	1	11	19	2	20	27	29	56	9
11	0.53	-	-	-	-	-	-	-	-
19	0.30	0.30	-	-	-	-	-	-	-
2	0.30	0.30	0.30	-	-	-	-	-	-
20	0.30	0.30	0.91	0.30	-	-	-	-	-
27	0.55	0.48	0.30	0.49	0.30	-	-	-	-
29	0.59	0.88	0.44	0.48	0.33	0.53	-	-	-
56	0.44	0.44	0.44	0.77	0.44	1.00	0.48	-	-
9	0.91	0.88	0.30	0.30	0.30	0.44	0.94	0.44	-
CTRL	0.33	0.48	0.55	0.30	0.48	0.30	0.48	0.44	0.32

TRC Index Left Rib 8

	1	11	19	2	20	27	29	56	9
11	0.52	-	-	-	-	-	-	-	-
19	0.30	0.30	-	-	-	-	-	-	-
2	0.30	0.30	0.30	-	-	-	-	-	-
20	0.30	0.30	0.88	0.30	-	-	-	-	-
27	0.58	0.47	0.29	0.52	0.28	-	-	-	-
29	0.59	0.88	0.43	0.47	0.35	0.52	-	-	-
56	0.43	0.43	0.43	0.77	0.43	1.00	0.47	-	-
9	0.88	0.88	0.30	0.28	0.28	0.43	0.93	0.43	-
CTRL	0.35	0.47	0.58	0.28	0.44	0.28	0.47	0.43	0.32

TRC Index Left Rib 9

	1	11	19	2	20	27	29	56	9
11	0.53	-	-	-	-	-	-	-	-
19	0.29	0.29	-	-	-	-	-	-	-
2	0.29	0.29	0.29	-	-	-	-	-	-
20	0.29	0.29	0.89	0.29	-	-	-	-	-
27	0.56	0.47	0.29	0.53	0.28	-	-	-	-
29	0.59	0.89	0.43	0.47	0.35	0.54	-	-	-
56	0.43	0.43	0.43	0.77	0.43	1.00	0.47	-	-
9	0.90	0.89	0.29	0.28	0.28	0.43	0.93	0.43	-
CTRL	0.35	0.47	0.59	0.28	0.47	0.28	0.47	0.43	0.29

TRC Index Left Rib 10

	1	11	19	2	20	27	29	56	9
11	0.53	-	-	-	-	-	-	-	-
19	0.30	0.30	-	-	-	-	-	-	-
2	0.30	0.30	0.30	-	-	-	-	-	-
20	0.30	0.30	0.89	0.30	-	-	-	-	-
27	0.58	0.48	0.24	0.53	0.23	-	-	-	-
29	0.59	0.89	0.45	0.48	0.35	0.53	-	-	-
56	0.45	0.45	0.45	0.77	0.45	1.00	0.48	-	-
9	0.89	0.89	0.24	0.23	0.23	0.45	0.94	0.45	-
CTRL	0.36	0.48	0.57	0.23	0.48	0.23	0.51	0.45	0.30

RSP Area Right Rib 3

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.42	0.42	-	-	-	-	-	-	-
20	0.78	0.42	0.26	-	-	-	-	-	-
22	0.78	0.42	0.42	0.78	-	-	-	-	-
27	0.61	0.42	0.36	0.78	0.96	-	-	-	-
29	1.00	0.42	0.36	0.93	0.88	0.87	-	-	-
56	0.48	0.48	0.42	0.42	0.87	0.78	0.67	-	-
9	0.42	0.42	0.73	0.36	0.42	0.41	0.42	0.61	-
CTRL	0.67	0.42	0.26	0.79	0.88	0.93	0.88	0.67	0.36

RSP Area Right Rib 4

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.44	0.44	-	-	-	-	-	-	-
20	0.78	0.44	0.31	-	-	-	-	-	-
22	0.78	0.44	0.44	0.76	-	-	-	-	-
27	0.63	0.44	0.31	0.76	0.95	-	-	-	-
29	1.00	0.44	0.37	0.93	0.87	0.87	-	-	-
56	0.48	0.48	0.44	0.44	0.87	0.76	0.66	-	-
9	0.44	0.44	0.73	0.37	0.47	0.44	0.44	0.62	-
CTRL	0.72	0.44	0.31	0.80	0.88	0.93	0.88	0.66	0.33

RSP Area Right Rib 5

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.43	0.43	-	-	-	-	-	-	-
20	0.78	0.44	0.33	-	-	-	-	-	-
22	0.78	0.44	0.43	0.72	-	-	-	-	-
27	0.68	0.43	0.33	0.72	0.94	-	-	-	-
29	1.00	0.43	0.36	0.93	0.88	0.87	-	-	-
56	0.48	0.48	0.43	0.45	0.87	0.72	0.70	-	-
9	0.43	0.43	0.72	0.36	0.44	0.36	0.43	0.54	-
CTRL	0.72	0.43	0.33	0.80	0.88	0.93	0.88	0.68	0.33

RSP Area Right Rib 6

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.43	0.43	-	-	-	-	-	-	-
20	0.78	0.44	0.29	-	-	-	-	-	-
22	0.78	0.44	0.43	0.78	-	-	-	-	-
27	0.63	0.43	0.33	0.78	0.96	-	-	-	-
29	1.00	0.43	0.34	0.94	0.87	0.87	-	-	-
56	0.48	0.48	0.43	0.44	0.86	0.78	0.65	-	-
9	0.43	0.43	0.74	0.34	0.48	0.43	0.43	0.56	-
CTRL	0.70	0.43	0.29	0.78	0.87	0.92	0.87	0.65	0.33

RSP Area Right Rib 7

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.43	0.43	-	-	-	-	-	-	-
20	0.78	0.44	0.32	-	-	-	-	-	-
22	0.78	0.44	0.43	0.78	-	-	-	-	-
27	0.64	0.43	0.32	0.78	0.95	-	-	-	-
29	1.00	0.43	0.32	0.93	0.88	0.88	-	-	-
56	0.48	0.48	0.43	0.44	0.88	0.78	0.64	-	-
9	0.43	0.43	0.78	0.32	0.44	0.43	0.43	0.62	-
CTRL	0.70	0.43	0.32	0.81	0.89	0.93	0.89	0.64	0.32

RSP Area Right Rib 8

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.43	0.43	-	-	-	-	-	-	-
20	0.78	0.43	0.38	-	-	-	-	-	-
22	0.78	0.43	0.43	0.76	-	-	-	-	-
27	0.65	0.43	0.38	0.78	0.95	-	-	-	-
29	1.00	0.43	0.38	0.92	0.89	0.88	-	-	-
56	0.48	0.48	0.43	0.43	0.88	0.76	0.71	-	-
9	0.43	0.43	0.76	0.38	0.43	0.43	0.43	0.59	-
CTRL	0.72	0.43	0.38	0.79	0.89	0.92	0.89	0.65	0.38

RSP Area Right Rib 9

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.43	0.43	-	-	-	-	-	-	-
20	0.78	0.44	0.36	-	-	-	-	-	-
22	0.78	0.44	0.43	0.78	-	-	-	-	-
27	0.67	0.43	0.36	0.78	0.95	-	-	-	-
29	1.00	0.43	0.43	0.93	0.88	0.88	-	-	-
56	0.48	0.48	0.43	0.44	0.87	0.78	0.67	-	-
9	0.43	0.43	0.78	0.43	0.46	0.43	0.43	0.62	-
CTRL	0.72	0.43	0.26	0.78	0.88	0.93	0.88	0.67	0.36

RSP Area Right Rib 10

	11	19	2	20	22	27	29	56	9
19	-	-	-	-	-	-	-	-	-
2	0.43	0.43	-	-	-	-	-	-	-
20	0.78	0.44	0.33	-	-	-	-	-	-
22	0.78	0.44	0.43	0.77	-	-	-	-	-
27	0.68	0.43	0.33	0.78	0.96	-	-	-	-
29	1.00	0.43	0.33	0.92	0.88	0.85	-	-	-
56	0.48	0.48	0.43	0.44	0.85	0.77	0.71	-	-
9	0.43	0.43	0.77	0.33	0.44	0.33	0.43	0.59	-
CTRL	0.71	0.43	0.33	0.82	0.88	0.92	0.88	0.69	0.33

RSP Area Left Rib 3

	1	11	19	2	20	27	29	56	9
11	0.161	-	-	-	-	-	-	-	-
19	0.161	0.161	-	-	-	-	-	-	-
2	0.161	1.000	0.161	-	-	-	-	-	-
20	0.087	0.522	0.084	0.679	-	-	-	-	-
27	0.084	0.096	0.161	0.161	0.161	-	-	-	-
29	0.161	0.409	0.161	0.732	0.207	0.084	-	-	-
56	0.352	0.604	0.352	1.000	1.000	0.679	0.441	-	-
9	0.084	0.084	0.604	0.084	0.084	0.084	0.084	0.216	-
CTRL	0.084	0.084	0.119	0.161	0.084	1.000	0.084	0.477	0.084

RSP Area Left Rib 4

	1	11	19	2	20	27	29	56	9
11	0.161	-	-	-	-	-	-	-	-
19	0.161	0.161	-	-	-	-	-	-	-
2	0.161	1.000	0.161	-	-	-	-	-	-
20	0.093	0.550	0.093	0.688	-	-	-	-	-
27	0.082	0.093	0.161	0.161	0.160	-	-	-	-
29	0.161	0.409	0.161	0.732	0.200	0.085	-	-	-
56	0.352	0.604	0.352	1.000	1.000	0.688	0.437	-	-
9	0.093	0.081	0.604	0.093	0.045	0.081	0.093	0.197	-
CTRL	0.060	0.084	0.098	0.161	0.084	1.000	0.085	0.437	0.045

RSP Area Left Rib 5

	1	11	19	2	20	27	29	56	9
11	0.161	-	-	-	-	-	-	-	-
19	0.161	0.161	-	-	-	-	-	-	-
2	0.161	1.000	0.161	-	-	-	-	-	-
20	0.093	0.532	0.118	0.692	-	-	-	-	-
27	0.075	0.100	0.161	0.161	0.161	-	-	-	-
29	0.161	0.409	0.161	0.732	0.207	0.093	-	-	-
56	0.352	0.597	0.352	1.000	1.000	0.719	0.429	-	-
9	0.093	0.075	0.597	0.093	0.075	0.075	0.111	0.207	-
CTRL	0.075	0.093	0.122	0.161	0.093	0.995	0.093	0.427	0.075

RSP Area Left Rib 6

	1	11	19	2	20	27	29	56	9
11	0.161	-	-	-	-	-	-	-	-
19	0.161	0.161	-	-	-	-	-	-	-
2	0.161	1.000	0.161	-	-	-	-	-	-
20	0.084	0.578	0.084	0.692	-	-	-	-	-
27	0.084	0.127	0.161	0.161	0.154	-	-	-	-
29	0.161	0.409	0.161	0.732	0.200	0.084	-	-	-
56	0.352	0.592	0.352	1.000	1.000	0.727	0.441	-	-
9	0.084	0.084	0.592	0.084	0.084	0.084	0.084	0.194	-
CTRL	0.084	0.084	0.118	0.154	0.084	1.000	0.084	0.455	0.084

RSP Area Left Rib 7

	1	11	19	2	20	27	29	56	9
11	0.16	-	-	-	-	-	-	-	-
19	0.16	0.16	-	-	-	-	-	-	-
2	0.16	1.00	0.16	-	-	-	-	-	-
20	0.12	0.52	0.12	0.69	-	-	-	-	-
27	0.10	0.12	0.16	0.16	0.13	-	-	-	-
29	0.16	0.41	0.16	0.73	0.20	0.12	-	-	-
56	0.35	0.60	0.35	1.00	1.00	0.70	0.43	-	-
9	0.11	0.11	0.60	0.12	0.10	0.11	0.12	0.18	-
CTRL	0.11	0.11	0.12	0.15	0.12	1.00	0.11	0.43	0.10

RSP Area Left Rib 8

	1	11	19	2	20	27	29	56	9
11	0.161	-	-	-	-	-	-	-	-
19	0.161	0.161	-	-	-	-	-	-	-
2	0.161	1.000	0.161	-	-	-	-	-	-
20	0.081	0.532	0.080	0.692	-	-	-	-	-
27	0.080	0.098	0.161	0.161	0.161	-	-	-	-
29	0.161	0.409	0.161	0.732	0.200	0.080	-	-	-
56	0.352	0.602	0.352	1.000	1.000	0.708	0.429	-	-
9	0.080	0.080	0.602	0.080	0.080	0.080	0.080	0.178	-
CTRL	0.080	0.080	0.101	0.161	0.080	1.000	0.080	0.425	0.080

RSP Area Left Rib 9

	1	11	19	2	20	27	29	56	9
11	0.161	-	-	-	-	-	-	-	-
19	0.161	0.161	-	-	-	-	-	-	-
2	0.161	1.000	0.161	-	-	-	-	-	-
20	0.093	0.545	0.093	0.692	-	-	-	-	-
27	0.068	0.114	0.161	0.161	0.128	-	-	-	-
29	0.161	0.409	0.161	0.732	0.200	0.080	-	-	-
56	0.352	0.604	0.352	1.000	1.000	0.713	0.441	-	-
9	0.075	0.072	0.604	0.080	0.068	0.085	0.090	0.183	-
CTRL	0.068	0.080	0.093	0.152	0.090	0.995	0.090	0.464	0.068

RSP Area Left Rib 10

	1	11	19	2	20	27	29	56	9
11	0.161	-	-	-	-	-	-	-	-
19	0.161	0.161	-	-	-	-	-	-	-
2	0.161	1.000	0.161	-	-	-	-	-	-
20	0.084	0.520	0.084	0.692	-	-	-	-	-
27	0.084	0.084	0.161	0.161	0.161	-	-	-	-
29	0.161	0.409	0.161	0.732	0.207	0.084	-	-	-
56	0.352	0.607	0.352	1.000	1.000	0.726	0.429	-	-
9	0.084	0.084	0.607	0.084	0.084	0.084	0.084	0.210	-
CTRL	0.084	0.084	0.116	0.161	0.084	1.000	0.084	0.429	0.084

Archaeological and Control Index Results Table

Site	Individual	Rib	Side	PA-index	TRC-index	RSP-AREA
RU	20	3	L	24.4	35.65	16.02
RU	20	4	L	18.96	45.99	21.58
RU	20	5	L	25.64	NA	NA
RU	20	6	L	20.41	32.1	21.06
RU	20	7	L	24.29	NA	NA
RU	20	8	L	30	32.64	16.92
RU	20	9	L	28.41	NA	NA
RU	20	5	R	26	46.32	21.42
RU	20	6	R	28.13	38.96	23.1
RU	20	7	R	31.11	31.11	25.2
RU	20	8	R	26.92	45.27	24.79
RU	27	3	L	23.91	NA	NA
RU	27	4	L	24.14	29.95	29.06
RU	27	5	L	23.33	35.16	29.12
RU	27	6	L	25.71	28.08	28.93
RU	27	7	L	20.41	21.84	16.53
RU	27	8	L	22.22	21.11	20.7
RU	27	9	L	27.03	21.86	25.26
RU	27	10	L	25.61	18.83	23.42
RU	27	3	R	25	41.72	23.78

RU	27	5	R	22.83	21.08	18.04
RU	27	6	R	29.07	23.11	25.97
RU	27	7	R	24.29	30.43	32.6
RU	27	8	R	25.81	24.53	27.56
RU	27	9	R	36.32	20.72	25.53
RU	27	10	R	25.61	16.88	23.7
RU	56	3	L	25	NA	NA
RU	56	4	L	24.29	NA	NA
RU	56	5	L	25.64	NA	NA
RU	56	6	L	21.15	NA	NA
RU	56	7	L	27.78	23.91	20.24
RU	56	3	R	25.81	NA	NA
RU	56	4	R	28.13	NA	NA
RU	56	5	R	25	36.71	22.91
RU	56	6	R	25	35.56	28.8
RU	56	7	R	32.95	NA	NA
RU	56	8	R	33.33	29.06	29.94
RU	29	3	L	30	NA	NA
RU	29	4	L	21.05	NA	NA
RU	29	5	L	24.29	27.54	13.11
RU	29	6	L	25	NA	NA
RU	29	7	L	27.78	NA	NA
RU	29	8	L	25.56	NA	NA

RU	29	9	L	28.57	29.25	15.8
RU	29	10	L	22.86	NA	NA
RU	29	3	R	26	NA	NA
RU	29	4	R	26.67	NA	NA
RU	29	5	R	25	NA	NA
RU	29	6	R	27.78	39.41	28.48
RU	29	7	R	25.56	29.94	20.88
RU	29	8	R	30.21	35.36	28.96
RU	29	9	R	21.74	26.11	16.09
RU	29	10	R	29.17	31.38	27.73
RU	11	4	L	27.78	27.88	18.98
RU	11	5	L	27.42	30.07	17.6
RU	11	6	L	23.61	NA	NA
RU	11	7	L	28.57	NA	NA
RU	11	8	L	29.49	NA	NA
RU	11	9	L	26.83	NA	NA
RU	11	10	L	25	27.89	15.07
RU	11	3	R	25	NA	NA
RU	11	4	R	24	NA	NA
RU	11	5	R	25.86	NA	NA
RU	11	6	R	27.78	29.07	21.5
RU	11	7	R	29.76	NA	NA
RU	11	8	R	25	NA	NA

RU	11	9	R	26.74	NA	NA
RU	22	4	L	20	NA	NA
RU	22	5	L	21.67	NA	NA
RU	22	6	L	25	NA	NA
RU	22	7	L	23.75	NA	NA
RU	22	8	L	22.09	NA	NA
RU	22	9	L	22.22	NA	NA
RU	22	3	R	19.64	NA	NA
RU	22	4	R	21.95	29.19	18.92
RU	22	5	R	23.86	25.63	25.37
RU	22	6	R	26.92	25.22	32.21
RU	22	8	R	29.35	22.37	26.83
RU	19	4	L	27.59	38.07	29.48
RU	19	5	L	30	35.83	31.32
RU	19	6	L	28.38	31.16	30.85
RU	19	3	R	25	NA	NA
RU	19	6	R	26.25	25.5	14.16
RU	1	5	L	28.89	26.72	40.76
RU	1	6	L	30	29.18	48.19
RU	1	7	L	30.61	26.64	44.68
RU	1	4	R	26.67	NA	NA
RU	1	5	R	31.43	NA	NA
RU	1	6	R	28.21	NA	NA

RU	1	7	R	24.42	NA	NA
RU	2	3	L	19.23	NA	NA
RU	2	7	L	20.21	18.5	13.84
RU	2	8	L	23.53	22.34	21.67
RU	2	3	R	20	44.12	31.88
RU	2	4	R	28.95	52.57	40.25
RU	2	5	R	27.5	NA	NA
RU	2	6	R	28.89	35.58	38.48
RU	2	7	R	26.6	25.91	31.35
RU	2	8	R	22.45	24.39	25.63
RU	9	3	L	25	36.53	25.47
RU	9	4	L	26.56	29.86	36.47
RU	9	5	L	30.23	29.26	38.36
RU	9	6	L	29.55	27	27
RU	9	7	L	30.85	24.9	37.36
RU	9	8	L	31.25	24.47	34.37
RU	9	9	L	30	25.57	30.66
RU	9	3	R	26.92	38.55	26.56
RU	9	4	R	23.33	37.3	31.91
RU	9	5	R	27.38	26.18	35.53
RU	9	6	R	27.91	NA	NA
RU	9	7	R	33.7	25.1	35.85
RU	9	8	R	30.43	NA	NA

RU	9	9	R	30	25.89	25.12
DU	CTRL	3	L	29.31	43.42	25.08
DU	CTRL	3	R	26.92	42.47	22.63
DU	CTRL	4	L	28.79	39.16	26.98
DU	CTRL	4	R	27.42	38.92	27.14
DU	CTRL	5	L	29.49	35	28.35
DU	CTRL	5	R	30	37.08	29.37
DU	CTRL	6	L	28.41	30	27.08
DU	CTRL	6	R	28.57	31.22	27.88
DU	CTRL	7	L	31.13	28.5	26.54
DU	CTRL	7	R	28.85	28.65	26.4
DU	CTRL	8	L	28.18	27.42	23.72
DU	CTRL	8	R	27.68	28.34	24.78
DU	CTRL	9	L	27.27	28	21.44
DU	CTRL	9	R	26.79	31.36	22.39
DU	CTRL	10	L	20.21	29.41	17.21
DU	CTRL	10	R	22.92	29.49	17.94

Thoracic Vertebrae Spinous Process Angle Results Table

Site	Individual	Vertebrae	Angle
RU	20	9	140
RU	27	1	128
RU	27	2	129
RU	27	3	129
RU	27	4	110
RU	27	5	101
RU	27	6	106
RU	27	7	110
RU	27	8	114
RU	27	9	124
RU	56	1	139
RU	56	2	132
RU	56	4	131
RU	56	6	106
RU	56	7	112
RU	56	9	116
RU	56	10	120
RU	56	11	125
RU	56	12	126
RU	11	1	140

RU	11	2	135
RU	11	3	130
RU	11	4	116
RU	11	5	110
RU	11	6	110
RU	11	7	115
RU	11	8	116
RU	11	9	120
RU	22	8	119
RU	22	9	120
RU	22	10	131
RU	19	1	135
RU	19	2	141
RU	19	3	135
RU	19	4	130
RU	19	5	119
RU	19	6	121
RU	19	7	118
RU	1	1	130
RU	1	2	129
RU	1	3	125
RU	1	4	121
RU	1	5	125

RU	1	6	134
RU	1	7	135
RU	1	8	132
RU	1	9	125
RU	1	10	129
RU	9	1	139
RU	9	2	139
RU	9	3	141
RU	9	4	135
RU	9	5	123
RU	9	6	129
RU	9	7	124
RU	9	8	121
RU	9	9	129
RU	9	10	136
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