NOTE: I wrote this paper a number of years as an excuse to gain experience with the wide range of bioarchaeological methods for determining stature. It is very much a rough draft, as reflected in the grammar and prose. Nonetheless, while it lacks polish and focuses on a single skeleton, the question it poses about stature method applicability for southern Florida osteological samples remains open. I may return to this topic one day, but I figured I would upload the paper in hope that someone else would examine this issue.

PF, June 2015

**Title:** **A Test of Stature Estimation from Prehistoric Southern Florida**

**Author:** **Peter Ferdinando**

**Keywords:** **Stature Estimation, Fully Method, Anatomical Height, South Florida, Belle Glade, Regional Cultures.**

## Abstract

This paper presents a brief examination of stature estimation in prehistoric southern Florida. Skeletal remains from this area during the Regional Cultures period (ca. 1000 B.C. - A.D. 1763) are often extremely fragmentary, disarticulated, commingled, or a combination thereof. Thus, the discovery of a relatively complete skeleton (BG-75-1A) allows for comparative testing of many commonly utilized techniques for estimating stature. For example, mathematically derived regression equations for the limb bones complied from European, African, East Asian, Mexican, precontact Mesoamerican, and prehistoric Ohio Native American populations, along with several other methods utilizing the metacarpals, metatarsals, and the calcaneus. Previously, no examination has been undertaken to determine if any of these non-local groups are applicable to precontact south Florida, and which approach, if any, most accurately reflects living stature.

The anatomical method was employed to determine living stature of BG-75-1A. It has been suggested that this technique provides the best estimation of stature. This permits comparison to the aforementioned mathematically derived equations. Consequently, it was possible to determine which formulas provide the best indicator of living stature in this single case. While one individual cannot represent an entire population, some comments can be made on the applicability of the various stature estimation techniques to the wider prehistoric populace of southern Florida.

## Introduction

It is acknowledged by a number of authors (Pearson, 1899; Trotter & Gleser, 1952, 1958; Genoves, 1967; Ubelaker, 1999; among many others) that the reliability of mathematically derived regression formulas for determining stature are directly related to the applicability of those equations to the population studied. Consequently, the selection of an appropriate formula for the population under study should include consideration of the genetic, environmental, and body proportions correspondence to the group from which the equations was originally developed (Pearson, 1899; Lundy, 1988; Sciulli et al., 1990; Holliday & Ruff, 1997; Wilbur, 1998). Yet, little discussion of this issue has occurred concerning the osteology of prehistoric south Floridians. Thus, during preparation of a lengthier report (Ferdinando, in press), a brief investigation of this issue was undertaken utilizing an unusually well-preserved skeleton (BG-75-1A) from the Belle Glade site in the Lake Okeechobee Archaeological Area (Carr & Beriault, 1984). It is hoped this brief project may foster further consideration of the issue of suitability when applying population-specific osteological techniques in southern Florida.

Indeed, researchers in Florida have used a variety of different systems to determine stature. Those include the mathematical formulas developed by Trotter & Gleser (1952; 1958) and Trotter (1970), Genoves (1967), and Musgrave & Harneja (1978). Additionally, the author wished to test several other methods, including those of Byers et al. (1989), Holland (1995), Wilbur (1998), and Sciulli et al. (1990).

This test was accomplished by a two-fold approach. First, the living stature of BG-75-1A was determined using the Fully anatomical method (Fully, 1956; Lundy, 1988; Sciulli et al., 1990; Raxter et al., 2006). While the true living stature of this individual can never be known, it has been suggested that the Fully technique produces the best estimate of living stature (Lundy, 1988; Sciulli et al., 1990; Ousley, 1995). Indeed, this method has been referred to as the 'golden standard' (Petersen, 2005:109). Second, stature was determined using the applicable regression formulas listed above. Consequently, comparative analysis between the anatomically derived stature and the various mathematically derived statures was undertaken. The results indicate a clear preference for several of these techniques.

## Materials and Methods

Human remains from south Florida's Regional Cultures period (ca 1000 B.C. - A.D. 1763) are often fragmentary, disarticulated, commingled, or a combination thereof. For example, over three hundred individuals were uncovered in the famous mounds and charnel pond complex at the Fort Center site (8GL12) (Sears, 1982), but no positive articulation between any bones could be demonstrated and no facial features remained (Miller-Shaivitz, 1986; Miller-Shaivitz and Iscan, 1991). Indeed, a number of osteological reports from Florida during this time period utilize the phase 'fragmentary remains' or some derivative (Iscan, 1983; Hutchinson, 1993; Iscan et al., 1995; Kessel, 2004; Winland, personal communication; among many others). Nonetheless, with the occasional occurrence of excellent preservation, hypothesis testing is possible.

The Belle Glade site complex includes a midden (8PB40) and a burial mound (8PB41) (Willey, 1949; Purdy, 1991). A large osteological collection was excavated from this site in the 1930s. Craniometric data for forty-three individuals was published in Hrdlicka (1940), and post-cranial data is discussed in Lille & Ludwig (2004). In the 1970s, Audrey J. Sublett led a salvage excavation at the burial mound and uncovered seven additional burials, including the relatively complete skeleton under review. This material is curated by The Palm Beach Museum of Natural History (Catalog #BG-75) and by Florida Atlantic University (Catalog #A-0955). With the exception of BG-75-1A, this collection is commingled, with no bones definitively associated.

BG-75-1A was examined utilizing the data collection system outlined in Buikstra and Ubelaker (1994). This individual was approximately 17-21 years old and was almost certainly female. For stature methods that required a specific age estimate, the midpoint, 19 years of age, was used. Finally, this individual appears relatively healthy, with little to no indication of paleopathological conditions or trauma that would influence stature estimation. However, a case of mild to moderate spina bifida occulta was present.

The Fully method estimates living stature by measuring each bony element that contributes to skeletal height, then correction factors are applied to account for missing soft tissue, the aging process, and certain measurement peculiarities (Fully, 1956; Lundy, 1988; Raxter et al., 2006). Two different methods of determining anatomical height using the Fully technique are discussed in this paper (Lundy 1988; Raxter et al., 2006). The differences are related to the specific measurement taken on certain bone, along with the correction factor. The Raxter et al. (2006) system is primary in this study, but both techniques were used to ensure that no bias was introduced while investigating the Ohio-derived mathematical equations, which were developed using the Lundy (1998) method.

The principal technique for assessing anatomical height in this study uses the Raxter et al. (2006) modified Fully method (hereon refereed to as RFM). This amended technique sort to correct an underestimation bias resulting from problems with the correction factor and unclear measurements landmarks found in the original method (King, 2004; Bidmos, 2005; Raxter et al., 2006). Detailed directions and illustrations can be found in Raxter et al. (2006:382-383). To convert this measure into living stature, the following two equations were used: Living Stature = [(1.009 X Skeletal Height) – (0.0426 X age + 12.1)] +/-2.22, if the age of the individual is known; Living Stature = [(0.996 X Skeletal Height) + 11.7] +/- 2.31, if age is not known.

While the RFM is primary, it was vital to establish living stature using the other anatomical method as outlined in Lundy (1988) and utilized by Sciulli et al. (1990) (hereon referred to as LSFM). Calculation using the LSFM was necessary for comparison to the prehistoric Ohio Native American equations developed using the LSFM method (Sciulli et al., 1990). The LSFM utilized the same measurements as described above, with the exception of using the maximum anterior height of each vertebra, and a different correction factor. For the LSFM correction factor, 10.0cm is added to skeletal heights less than 153.5cm, 10.5cm to skeletal heights between 153.6 and 165.4cm, and 11.5cm to skeletal heights greater than 165.5cm. These correction factors account for the missing soft tissue, along with several other factors such as aging (Fully, 1956; Lundy, 1988; Raxter et al., 2006). Additionally, it should be noted that no standard error is mentioned in Lundy (1988).

When using either anatomical method, procedures have been developed to account for missing or incomplete bones. BG-75-1A is missing four vertebrae (C3, C5, T9, T11), and both the left and right talus. Using the procedure described in Sciulli et al. (1990), the absent vertebral heights were estimated by averaging the height of the vertebrae immediately above and below the missing element. However, to estimate the height of C3, the average of C2 and C4 would have produced an erroneous result. This is due to the inclusion of the odontoid process of the axis, resulting in a significantly larger height then the other applicable cervical vertebrae (C3-C7). Consequently, an estimate for C3 was devised by reviewing the percentage that each vertebra contributes to the total vertebral column (Sciulli et al., 1990). Concerning the missing talus, a different procedure was developed. Scrutinizing the 1970s Belle Glade skeletal collection, a total of fourteen talus bones were complete enough to be measured. However, due to the commingled nature of the collection, age and sex are unknown. The total height of each talus was measured, from the most superior to the most inferior point. The average of these measurements was added to the height of the calcaneus from the lowest anterior point where the talus articulates with the calcaneus to the inferior point of the calcaneal tuber. Both bones were held in the anatomical position while measured. This measurement replicates the combined articulate height of these two bones. While this substitution is not ideal, due to the small percentage this bone contributes to overall height, any errors should not greatly influence the results.

Trotter & Gleser (1952; 1958) and Trotter (1970) developed a range of equations using the femur, tibia, fibula, humerus, ulna, and radius. However, there are several issues with the use of these formulas. First, there are known measurement irregularities with the tibia (Ubelaker, 1999:61). Additionally, the standard errors associated with the upper limbs are larger than those of the lower limbs. Consequently, due to the measurement problem with the tibia, and the lack of complete fibulas in this case, only the femur was measured. Maximum length (MAXF) of the left and right bones was taken, and this measure was averaged. It should be noted that the equations for Mexican and Mongoloid populations were only developed for males. Thus, for this test the equations for White and Black females were used. Several authors (Iscan, 1983; Wilbur, 1998) have previously employed the formula for White females as a substitution for the missing Mongoloid equation.

Genoves (1967) sort to reconstruct the precontact condition of Mesoamerica, and the resulting stature equations are available for both males and females. Formulas were devised for the femur and the tibia, both of which were used in this study. The femur was measured for maximum length (MAXF), and the average of the two sides was used. For the tibia, the length of the bone excluding the tuberosity was measured, with the left and right sides averaged. Additionally, Genoves (1967:76) advises that 2.5cm should be subtracted to gain an estimate of living stature.

Musgrave & Harneja's (1978) metacarpal method of stature estimation has previously been used in Florida (Stojanowski & Doran, 1998). Indeed, such stature estimations derived from metacarpals, metatarsals, and the tarsal bones are invaluable for use with fragmentary remains. In this case, the left fourth metacarpal and right second metacarpal were missing or damaged, but measurements were taken for the other eight bones. The physiological length was measured for each available metacarpal, detailed guidelines are found in Musgrave & Harneja (1978:119). It should be noted that this specific method was developed using primarily White British citizens.

Byers et al. (1989) demonstrated that metatarsal length is significantly correlated with stature in Euro-Americans and Afro-Americans. Only the left fifth metatarsal of BG-75-1A was recovered. Two different measurements were considered on this element: functional length (FMT) and morphological length (MMT). FMT was taken from dorsoplantar midpoint of the intersection between the forth metatarsal and cuboid facets to the apex of the capitulum. MMT was measured from the tip of the tuberosity to the apex of the capitulum.

Holland (1995) investigated the relationship between stature and the calcaneus and/or talus in American Whites and American Blacks. For this study, the right calcaneus was investigated. Two measurements were taken: maximum length (MCAL) and posterior length (PCAL). The former is the maximum length of the calcaneus as taken parallel to the long axis. The latter is the maximum length between the most anterior point of the posterior talar articular surface and the most posterior point of the calcaneus (on the tuberosity ignoring any extensive exostoses).

Wilbur (1998) developed several equations for use with metacarpals and metatarsals, using a prehistoric west-central Illinois Native American population dating from the Middle Woodland to the Mississippian periods (A.D. 1-1100). For this case, only the left second and third metacarpals, along with the right second metacarpal were measured. Rather than producing a stature estimate, this technique generates an estimate of maximum femur length (MAXF). Wilbur (1998) notes the lack of a female Mongoloid equation by Trotter (1970), and suggests substituting the formula for White females. In addition, the Mesoamerican female standard of Genoves (1967) was employed in this case.

Finally, Sciulli et al. (1990) presented a variety of regression equations developed using a prehistoric Native American population from Ohio. This population ranged in time through the Late Archaic, Middle Woodland, Late Woodland, and the Mississippian periods (ca. 3000-ca. 400 years B.P.). These formulas were developed, because the commonly used equations produced results 2-8cm in excess of living stature estimates generated by the LSFM anatomical method. Sciulli et al. (1990) and Sciulli & Giesen (1993) suggest this underestimation is due to a difference in proportions of the lower limbs of Ohio Native Americans compared to East Asian and recently diverged East Asian-derived populations. Regression equations were developed for a variety of different bones and bone combinations, including the physiological length of the femur (PLF), maximum length of the femur (MAXF), length of tibia from the condyle to malleolus, the sum of the physiological femur length (PLF) and tibia length, the sum of the physiological femur (PLF), the tibia from the condyle to malleolus, and the height of the lumbar vertebrae, and the sum of the second cervical vertebrae through the first segment of the sacrum. The resulting estimates are skeletal height. Thus, Sciulli et al. (1990) used the correction factors of Fully (1956) to determine living stature. These factors were detailed earlier in this article.

## Results and Discussions

Table 1 lists the resultant living stature estimates for BG-75-1A and the standard error for each method. Each estimate is numbered and hereon referred to as such. Figure 1 graphically represents the standard error distributions of each technique. Nine distinct points are observable from these results. In all cases, the age adjusted RFM stature estimate (1) is taken as the 'golden standard' and is the principal for comparison. The living stature estimate of (1) is 151.46cm +/-2.22.

First, comparing the RFM age adjusted estimate (1) with the non-adjusted estimate (2), it is clear there is a slight underestimation in the latter. This is not unexpected. BG-75-1A was a young individual, and the onset of age related height loss had yet to occur. Youthful age is accounted for in (1), but not in (2). While (2) is an underestimate of only 1.40cm, it does demonstrate that for the best results, an age estimate should be known prior to attempting to estimate stature with this method.

Second, there is a clear divergence between the RFM technique (1) and the LSFM method (3) of determining anatomical stature. This dissimilarity was 2.54cm. This is quite similar to the 2.4cm underestimation found by Raxter et al. (2006) and close to the findings of several other authors (King, 2004; Bidmos, 2005).

Third, utilizing the White Females (4) and Black Females (5) formulas of Trotter (1970), several things are evident. Interestingly, while the White formula had previously been used as a substitute, the Black formula produced the better estimate. Indeed, while (4) overestimated living stature by 2.18cm, (5) is only 0.18cm larger than (1). This result may indicate that the contribution of the African-derived population's femur to overall living stature is similar to that of prehistoric south Florida Native Americans. As a result, it maybe advisable to test the applicability of Trotter's (1970) equation for Black femurs as a substitute in future study of south Florida populations.

Fourth, the best results were obtained using Genoves' (1967) formulas for precontact Mesoamericans. For the femur (6), the resulting estimate was 0.16cm over that of (1). Interestingly, the estimates of (6) and of Trotter's (1970) Black femur (5) are almost identical, and the standard errors are also reasonably comparable. This point furthers the possibility that the femur's relative contribution to overall stature is comparable between south Florida groups and African-derived populations studied by Trotter (1970). However, the tibia (7) produced an underestimate of 1.78cm. This may indicate a difference in the relationship between the femur and the tibia in south Florida populations compared to Genoves' (1967) Mesoamericans. As this formula is used commonly in south Florida, this possible snag with the tibia should be further investigated.

Fifth, the standard of error for the various methods using the metacarpals, metatarsals, and tarsals is usually larger than that using the limb bones. Nonetheless, there is some promise with these techniques. Using Musgrave & Harneja (1978), (8-15) all overestimate living stature by 5-10cm. However, (9) appears to be in disagreement with the other estimates and maybe erroneous. Removing (9), the overestimation from the other metacarpals (8, 10-15) is between 4-7cm; a more reasonable range. Consequently, it is possible that this method merely overestimates height in south Florida remains. As a result, it is perhaps advisable to investigate a potential correction factor for this method. From this single example, it appears that the subtraction of approximately 5.5cm could realign these estimates. Nonetheless, this suggestion must be tested.

Sixth, analyzing the fifth metatarsal using the methods of Byers et al. (1989), two similar results (16, 17) were produced. While both overestimated living stature by about 3cm, a significant portion of the lower end of their standard error was within that of the standard error of (1). As with the Musgrave & Harneja (1978) method (8, 10-15), it appears this technique merely overestimates living stature. Consequently, the subtraction of a factor of approximately 3cm should be investigated.

Seventh, the Holland (1995) method using the calcaneus also produced similar results. Both (18) and (19) overestimated living stature by 2-4cm. Nonetheless, these results were close to that of (1). Moreover, the standard of error of this method is smaller than many of the other systems using the bones of the hands and/or feet. Once again, a correction factor could be developed to realign this method for application to south Florida populations.

Eighth, it is interesting to note that the only technique using the bones of the hands and/or feet that was developed on prehistoric Native Americans also produces overestimates. This seemingly indicates that south Floridians may have been distinct in metacarpal, metatarsal, and/or tarsal dimensions when compared to other populations. Using the Wilbur (1998) method with the Genoves (1967) femur equations, (20-22) all overestimate living stature by 3-5cm. Nonetheless, the standard of error ranges were within that of (1). Using Wilbur (1998) with the Trotter (1970) equations (23-25), several interesting points are observable. First, once again the Trotter (1970) White formulas produce stature estimates larger than that of Genoves (1967). Second, these estimates (23-25) are 2-3cm larger than that of (20-22). Third, even with a rather large standard of error, almost 7cm, the range of (23) almost emerges from the entire standard error of (1). As with the other methods using the hand and/or feet, it appears that the Wilbur (1998) method could be used in south Florida, but with a correction factor of about 4cm. However, such a development should only use the equations of Genoves (1967).

Ninth, it is abundantly clear that the equations developed for the prehistoric Native Americans of Ohio are not applicable to south Florida. Using either RFM (1) or LSFM (3), none of the six stature estimates (26-31) are accurate. Indeed, (26-30) all significantly underestimate living stature when compared to (1). Additionally, (31) appears to be an erroneous result, out of line with (26-30) and not aligned with either (1) or (3). This is not unexpected; Sciulli et al. (1990) note that utilizing the height of the vertebral column is the most inaccurate method. The troubles with using this method are not surprising. Indeed, the Ohio formulas were developed because the prehistoric populations of that area had different bone proportions when compared to certain other groups. Indeed, this result merely reiterates why testing of stature estimation technique for precontact south Florida individuals is essential.

Body proportions of prehistoric south Florida Native Americans, especially the lower limbs, must be studied to see if any of the above suggestions are indeed the case. Certainly, using Genoves' (1967) equations, the estimate from the femur (6) is significantly superior to that of the tibia (7). While this is a single case, it may indicate a distinct proportional relationship between the femur and tibia in southern Florida. Consequently, the crural index of a number of south Florida remains should be measured and compared to that from other populations. In this case, the crural index (tibia length X 100/femur length) of BG-75-1A is 80.65%. If south Florida groups consistently have shorter tibias relative to femurs when compared to other populations, this detail should be considered in any estimate of stature.

Using the various stature estimation techniques for the metacarpals, metatarsals, and the tarsals, it is apparent that each method overestimates living stature in this case. Consequently, two possibilities should be investigated: newly devised equations and/or correction factors for previously developed formulas. While developing new equations for each of these bones would be the preeminent solution, this does not seem possible due to the fragmentary nature of many south Florida collections. Consequently, the only solution maybe to confirm the preliminary results from this study with that from any other relatively complete south Florida remains. Even if a limited number of skeletons ($\geq$15) can be analyzed, the suggestions of this article may be enhanced and substantiated.

Finally, while not used in this case, an additional method of note concerning stature estimation should be discussed. Petersen (2005) investigated utilizing skeletal length in the grave to estimate stature. This technique produced an average overestimation of only 0.08cm, when compared to an anatomical-derived estimate. This method is used for well-preserved skeletons discovered in the extended supine position, with the cranium and one talus in an undisturbed state. Utilizing a folding ruler, and measuring along the sagittal midline of the skeleton, the skeleton is measured from the most distal point on the talus to the cranial point farthest from the skeleton. Importantly, this method does not need any correction factors or any control for age, sex, or population. Indeed, BG-75-1A was reportedly discovered in the extended supine position, and could have been measured using skeletal length in grave. Hopefully, this technique can be utilized for future work in southern Florida.

## Conclusions

There has been little discussion of the appropriateness of the various stature estimation techniques utilized in studying the physical anthropology of the prehistoric populations of southern Florida. Indeed, this single case is nothing more than the start of such inquiry. Nonetheless, several points are quite clear. Most notable, when compared to the Raxter et al. (2006) modified Fully anatomical method, the Genoves' (1967) equation for the femur seems to be the most appropriate for this population. Moreover, due to fragmentary nature of finds in southern Florida, the applicability of stature estimation methods using the bones of the hands and/or the feet is also important. While no methods are perfect, indeed they all overestimate stature, with analysis either new equations, or correction factors could be developed.

Consequently, three avenues of future investigation are vital. First, additional studies similar to this article are imperative. Collections containing south Florida osetological material must be investigated for other reasonably complete skeletons. If a sizable population can be found and studied ($\geq$15), then the preliminary conclusions of this article can be scrutinized. Second, body proportions, especially examining and comparing the crural index, should be explored. Similar body proportions are a vital component to selecting the most appropriate mathematically derived stature estimation technique. Finally, stature analysis comparing and contrasting age, sex, health, and burial location can also be informative. Any differences may reveal a number of interesting insights, including possible hallmarks for social stratification (Haviland, 1967). Indeed, accurate estimations of stature are fundamental to ensure the veracity of any wider conclusions concerning the precontact peoples of southern Florida.

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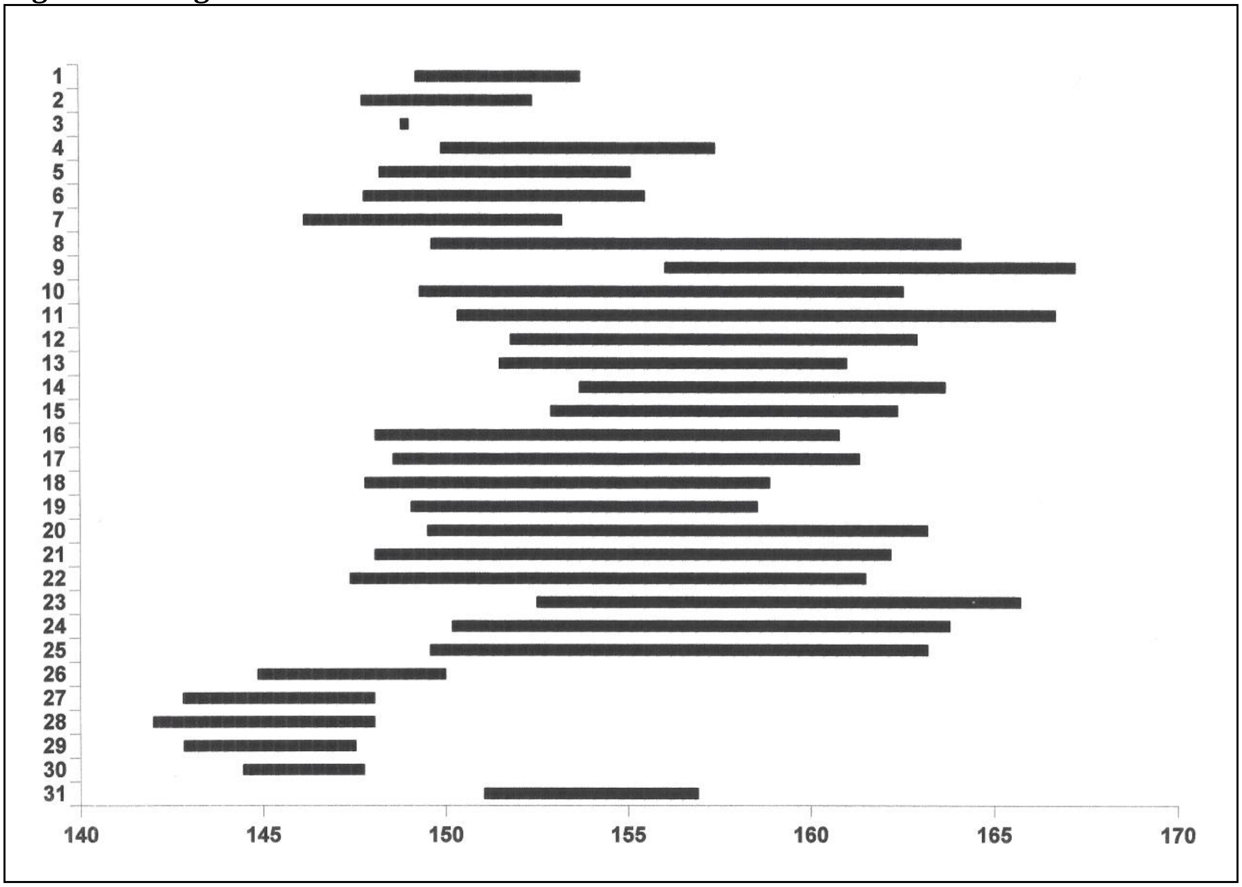
**Table 1: Stature Estimates for BG-75-1A**

| # | **Method** | **Population** | **Bone** | **Living Stature (cm)** |
|---|---|---|---|---|
| 1 | RFM age adjusted | BG-75-1A | Anatomical Height | 151.46 +/- 2.22 |
| 2 | RFM | BG-75-1A | Anatomical Height | 150.06 +/- 2.31 |
| 3 | LSFM | BG-75-1A | Anatomical Height | 148.92 |
| 4 | Trotter 1970 | White American | Femur | 153.64 +/- 3.72 |
| 5 | Trotter 1970 | Black American | Femur | 151.64 +/- 3.41 |
| 6 | Genoves 1967 | Mesoamerican | Femur | 151.62 +/- 3.816 |
| 7 | Genoves 1967 | Mesoamerican | Tibia | 149.68 +/- 3.513 |
| 8 | M & H 1978 | White British | Left Metacarpal I | 156.86 +/- 7.21 |
| 9 | M & H 1978 | White British | Left Metacarpal II | 161.59 +/- 5.58 |
| 10 | M & H 1978 | White British | Left Metacarpal III | 155.91 +/- 6.59 |
| 11 | M & H 1978 | White British | Left Metacarpal V | 158.49 +/- 8.14 |
| 12 | M & H 1978 | White British | Right Metacarpal I | 157.33 +/- 5.54 |
| 13 | M & H 1978 | White British | Right Metacarpal III | 156.22 +/- 4.73 |
| 14 | M & H 1978 | White British | Right Metacarpal IV | 158.66 +/- 4.98 |
| 15 | M & H 1978 | White British | Right Metacarpal V | 157.62 +/- 4.72 |
| 16 | Byers et al. 1989 | WA & BA | Metatarsal V (FMT) | 154.42 +/- 6.33 |
| 17 | Byers et al. 1989 | WA & BA | Metatarsal V (MMT) | 154.94 +/- 6.36 |
| 18 | Holland 1995 | WA & BA | Calcaneus (MCAL) | 155.33 +/- 5.52 |
| 19 | Holland 1995 | WA & BA | Calcaneus (PCAL) | 153.80 +/- 4.72 |
| 20 | Wilbur 1998 (Genoves 1967) | Prehistoric Illinois | Left Metacarpal II | 156.34 +/- 6.82 |
| 21 | Wilbur 1998 (Genoves 1967) | Prehistoric Illinois | Left Metacarpal III | 155.12 +/- 7.04 |
| 22 | Wilbur 1998 (Genoves 1967) | Prehistoric Illinois | Right Metacarpal III | 154.43 +/- 7.04 |
| 23 | Wilbur 1998 (Trotter 1970) | Prehistoric Illinois | Left Metacarpal II | 159.10 +/- 6.59 |
| 24 | Wilbur 1998 (Trotter 1970) | Prehistoric Illinois | Left Metacarpal III | 156.98 +/- 6.79 |
| 25 | Wilbur 1998 (Trotter 1970) | Prehistoric Illinois | Right Metacarpal III | 156.38 +/- 6.79 |
| 26 | Sciulli et al. 1990 | Prehistoric Ohio | Femur (PLF) | 147.43 +/- 2.56 |
| 27 | Sciulli et al. 1990 | Prehistoric Ohio | Femur (MAXF) | 145.43 +/- 2.61 |
| 28 | Sciulli et al. 1990 | Prehistoric Ohio | Tibia | 145.02 +/- 3.02 |
| 29 | Sciulli et al. 1990 | Prehistoric Ohio | Femur (PLF)+Tibia | 145.18 +/- 2.34 |
| 30 | Sciulli et al. 1990 | Prehistoric Ohio | Femur (PLF)+ Tibia+Lumbar | 146.11 +/- 1.64 |
| 31 | Sciulli et al. 1990 | Prehistoric Ohio | Vertebral Column | 153.98 +/- 2.92 |

-Musgrave & Harneja 1978=M & H 1978;
-White American & Black American=WA & BA;
-Estimate #3 has no standard of error.

**Figure 1: Range of Stature Estimations**




-X Axis: living stature in cm;
-Y Axis: stature estimate number;
-Note: Estimate #3 had no standard of error.