# Appendicular Lean Soft Tissue Changes Monitored by DXA and Anthropometric Equations in Professional Soccer Players

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## ABSTRACT:

The assessment of appendicular lean soft tissue (ALST) can provide an estimation of skeletal muscle mass, but little is known about monitoring changes in athletes using anthropometric equations (AE).

***PURPOSE:*** To compare the ability of AE to correctly evaluate changes over time in ALST using DXA as the reference method.

***METHODS:*** 42 soccer players aged 16—34 years, were evaluated in several occasions with DXA and 5 AE (Quiterio, Arngrimsson, Kulkarni, Table 1), from 2009 to 2015 with at least a difference of 6 months (range 2—7 evaluations). For each subject all results of ALST were compared between them. The ALST changes in DXA and AE were classified as a) increase (>1%); b) decrease (<-1%); c) no change (≥-1% to ≤1%). When both, DXA and AE, had the same change or no change (a, b or c) it was counted as a coincidence and as an inconsistency when both results were not the same.

***RESULTS:*** Table 1 shows the overall results of coincidences and iconsistencies of the equations compared with DXA. When there was an increase in ALST (a), the equations by Quiterio, Kulkarni and Arngrimsson (3 skinfolds) had the same percentage of coincidences and had more coincidences with DXA. With a decrease in ALST (b), the Quiterio's equation had more coincidences with DXA; and when there was no change in ALST (c), the Kulkarni's equation had more coincidences with DXA. In the overall, Arngrimsson's (3 skinfolds) and Quiterio's equations had the most coincidences with DXA.

***CONCLUSIONS:*** Arngrimsson's (3 skinfolds) and Quiterio's equations assessed better the changes of ALST in our sample. Nonetheless, the overall results found in this study show that estimating ALST by AE is not a reliable method to follow up changes over time on this tissue.

## INTRODUCTION

The appendicular lean soft tissue (ALST) can be used to assess the skeletal muscle mass. Changes in ALST can tell us if an exercise and/or nutrition intervention is working or not. Several anthropometric equations (AE) have been developed to predict ALST, however, their ability to correctly assess changes in ALST over time is not known.

Therefore, the purpose of this study was to compare the ability of AE to correctly evaluate changes in ALST over time using Dual-Energy X-Ray Absorptiometry (DXA) as the reference method.

## METHODS

Forty two professional male soccer players (aged 16—34 years), were evaluated in several occasions with DXA and five AE (Quiterio, Arngrimsson 7 skinfolds, Arngrimsson 3 skinfolds, Arngrimsson 1 skinfold, and Kulkarni, Table 1), from 2009 to 2015 with at least a difference of six months (range 2—7 evaluations). The anthropometric measurements were assessed by trained personnel using a Harpenden skinfold caliper and a Rosscraf tape for circumferences. The DXA whole body scan was performed with a Hologic Explorer QDR equipment and analyzed by a certified technician. For each subject all results of ALST were compared between them, there were 156 combinations. The ALST changes in DXA and AE were classified as: a) increase (>1%); b) decrease (<-1%); c) no change (≥-1% to ≤1%).

When both, DXA and AE, had the same change or no change (a, b or c) it was counted as a coincidence and as an inconsistency when both results were not the same. The amount of coincidences was reported as percentage.

## RESULTS

When there was an increase in ALST (a), the equations by Quiterio, Arngrimsson (3 skinfolds) and Kulkarni had more coincidences with DXA. With a decrease in ALST (b), the Quiterio's equation had more coincidences with DXA, followed by Arngrimsson (3 skinfolds), and when there was no change in ALST (c), the Kulkarni's equation had more coincidences with DXA (Table 1).

In the overall results, we found that Arngrimsson's (3 skinfolds) and Quiterio's equations had the most coincidences with DXA (Figure 1).

**Table 1.** Percentages of coincidences of appendicular lean soft tissue (ALST) changes assessed with anthropometric equations (AE) compared with DXA (n = 42 subjects, 156 combinations)

| Changes in ALST with DXA | Changes in ALST with AE | Quiterio | Arngrimsson (7 skinfolds) | Arngrimsson (3 skinfolds) | Arngrimsson (1 skinfold) | Kulkarni |
|---|---|---|---|---|---|---|
| **Increase** | Decrease | 35.7 | 35.7 | 28.6 | 50.0 | 35.7 |
| | No change | 28.6 | 39.3 | 35.7 | 25.0 | 28.6 |
| | **Increase** | 35.7 | 25.0 | 35.7 | 25.0 | 35.7 |
| | Inconsistencies | 64.3 | 75.0 | 64.3 | 75.0 | 64.3 |
| **Decrease** | **Decrease** | 85.2 | 76.2 | 80.2 | 74.3 | 74.3 |
| | No change | 8.9 | 17.9 | 14.8 | 15.8 | 16.8 |
| | Increase | 5.9 | 5.9 | 5.0 | 9.9 | 8.9 |
| | Inconsistencies | 14.8 | 23.8 | 19.8 | 25.7 | 25.7 |
| **No change** | Decrease | 66.7 | 66.7 | 56.6 | 70.4 | 40.7 |
| | **No change** | 7.4 | 22.2 | 29.6 | 22.2 | 40.7 |
| | Increase | 25.9 | 11.1 | 14.8 | 7.4 | 18.5 |
| | Inconsistencies | 92.6 | 77.8 | 70.4 | 77.8 | 59.2 |

## CONCLUSIONS

Arngrimsson's (3 skinfolds) and Quiterio's equations were the best for assessing the changes of ALST in our sample. However, if we take into account the magnitude of coincidences, not coincidences and contrary results found in this study, using these AE could not be a reliable method for monitoring ALST over time, therefore, they should be used cautiously.

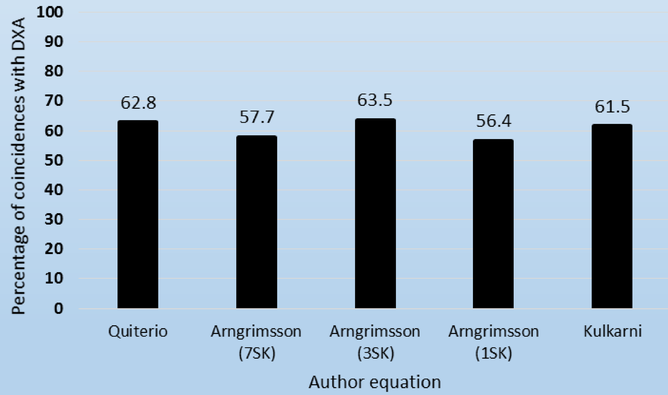


**Figure 1**. Overall percentage of coincidences on ALST assessment for each anthropometric equation and DXA. SK, skinfolds. (n =42 subjects, 156 combinations).

## REFERENCES

Arngrimsson SA, et al. Med Sci Sports Exerc. 41; 2009.

Kulkarni B, et al. J Appl Physiol. 115; 2013.

Quiterio A, et al. Med Sci Sports Exerc. 41; 2009.