

# Inconsistencies Found With Anthropometric Equations on Assessing Body Fat Changes Over Time in Soccer Players





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#### **ABSTRACT:**

In 2014 our laboratory presented data showing that the anthropometric equations (AE) for % body fat (%BF) estimations that were more in agreement with DXA in a cross-sectional design were Oliver, Wilmore, Civar, and Durnin & Womersley, but little is known about the applicability of these equations to estimate % BF changes over time.

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

METHODS: Forty two soccer players (16 to 34 years old), were evaluated on several occasions with DXA and 4 anthropometric equations from 2009 to 2015 with at least a difference of six months (range 2 to 7 evaluations). For each subject all results of %BF were compared between them. The %BF changes in DXA and AE were classified as:

a) increase (>1%); b) decrease (<-1%); c) no change (between ≥ -1% and ≤1%). When 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:** The complete analysis is shown in table 1. When there was an increase in %BF (a), the equations by Oliver and Durnin & Womersley had the same percentage of coincidences and were the ones that had more coincidences with DXA. With a decrease in %BF (b), the Oliver's equation was the one with more coincidences with DXA, and with no change in %BF (c), the Civar's equation had more coincidences with DXA. In the overall results Oliver's and Wilmore's equations had the most coincidences with DXA.

**CONCLUSIONS:** In this study Oliver's and Wilmore's equations were the ones that showed a better follow up in changes in %BF, but from an overall perspective, and given the low percentage of coincidences, caution should be taken when interpreting results of %BF over a period of time.

## INTRODUCTION

The assessment of body fat percentage (%BF) is a very common practice in sports. It can be estimated employing anthropometric measurements that predicts %BF. There are several anthropometric equations (AE) that estimate %BF. In 2014, our laboratory presented data about the accuracy of AE compared with Dual-Energy X-Ray Absorptiometry (DXA) in professional soccer players, showing that Oliver's, Wilmore & Behnke's, Civar's, and Durnin & Womersley equations had the best agreement with DXA in a cross-sectional study. However, if these equations are able to correctly follow up changes on %BF is not completely elucidated. Therefore, the purpose of this study was to compare the ability of AE to correctly evaluate changes over time in %BF using DXA as the reference method.

# METHODS

Forty two professional male soccer players (16 to 34 years old), were evaluated on several occasions with DXA and four AE from 2009 to 2015 with at least a difference of six months (range 2 to 7 evaluations). The DXA whole body scan was performed with a Hologic Explorer QDR equipment and analyzed by a certified technician. The anthropometric measurements were assessed by trained personal using a Harpenden skinfold caliper. The four AE analyzed were Oliver, Wilmore & Behnke, Civar, and Durnin & Womersley. For each subject all results of %BF were compared between them, there were 156 combinations. The %BF changes in DXA and AE were classified as: a) increase (>1%); b) decrease (<-1%); c) no change (between ≥ -1% and ≤1%). When 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

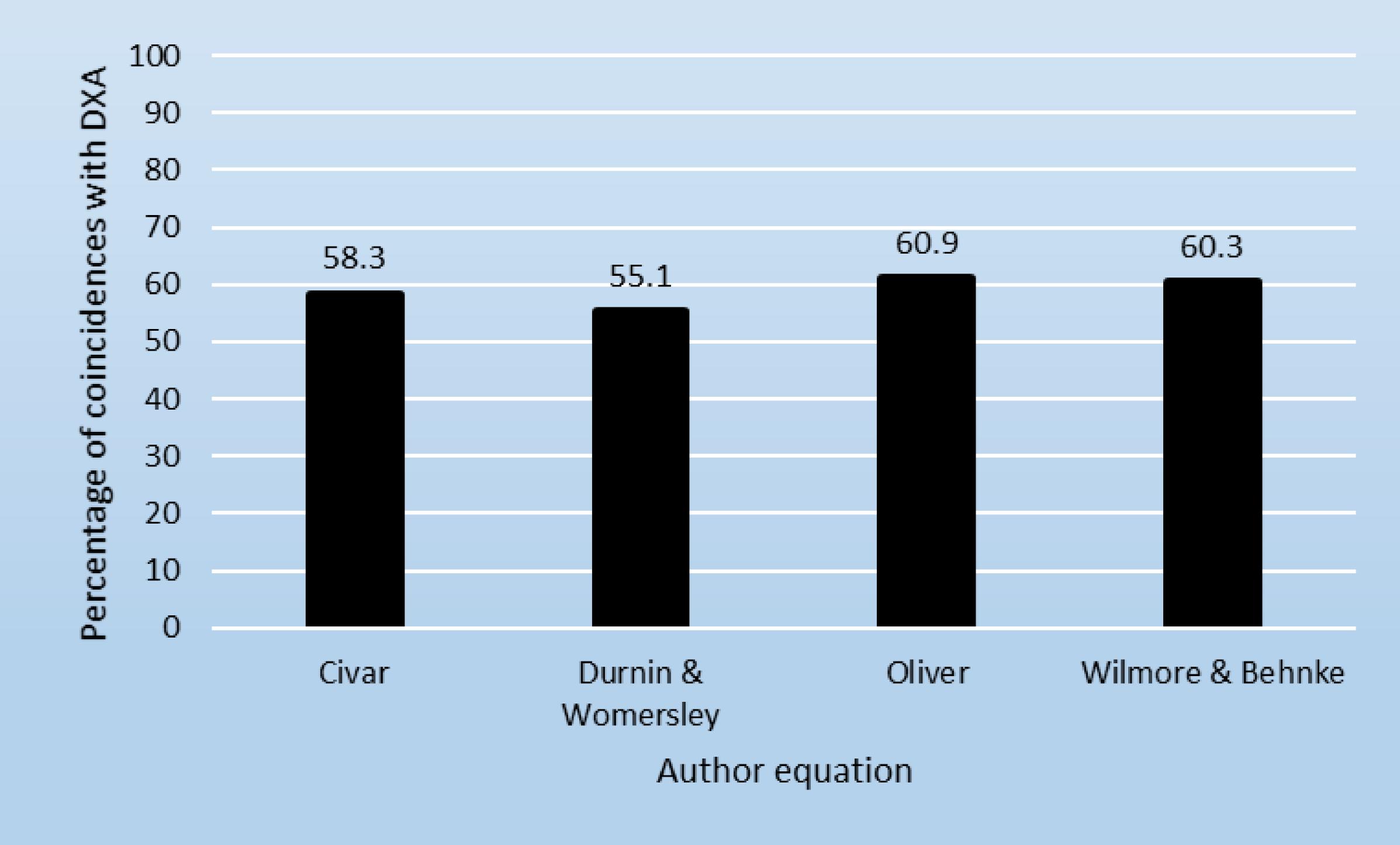
When there was an increase in %BF (a), the equations by Oliver and Durnin & Womersley had the same percentage of coincidences and were the ones that had more coincidences with DXA. With a decrease in %BF (b), the Oliver's equation was the one with more coincidences with DXA, and with no change in %BF (c), the Civar's equation had more coincidences with DXA (Table 1). There were some cases in which the AE estimated the contrary of the DXA evaluation. When DXA assessed an increase in %BF, AE estimated the contrary, by 4.7% to 9.3% of the cases, except for Civar's equation. When DXA assessed a decrease in %BF, two AE did not estimate the contrary and the equation of Durnin & Womersley was the one that most estimated the contrary (Table 1). As it is difficult to know which of these combinations are happening we reported the overall coincidences. This analysis showed that Oliver's and Wilmore & Behnke's equations had the most coincidences with DXA estimating %BF changes (Figure 1).

**Table 1.** Percentages of coincidences of body fat percentage (%BF) changes assessed with anthropometric equations (AE) compared with DXA.

Changes in %BF with DXA	Changes in %BF with AE	Civar	Durnin & Womersley	Oliver	Wilmore & Behnke
Increase	Decrease	0	6.9	4.7	9.3
	No change	51.2	32.6	34.8	32.6
	Increase	48.8	60.5	60.5	58.1
	Inconsistencies	51.2	39.5	39.5	41.9
Decrease	Decrease	59.1	56.8	61.4	59.1
	No change	40.9	29.6	34.1	40.9
	Increase	0	13.6	4.5	0
	Inconsistencies	40.9	43.2	38.6	40.9
No change	Decrease	11.6	17.4	13.0	11.6
	No change	63.8	50.7	60.9	62.3
	Increase	24.6	31.9	26.1	26.1
	Inconsistencies	36.2	49.3	39.1	37.7

#### CONCLUSIONS

In this study, Oliver's and Wilmore & Behnke's equations were the ones that showed a better follow up in changes in %BF compared with DXA, but from an overall perspective, and given the low percentage of coincidences, caution should be taken when interpreting results of %BF with AE in professional male soccer players over a period of time.



**Figure 1.** Overall percentage of coincidences for each anthropometric equation for %BF and DXA. (n =42 subjects, 156 combinations).

# REFERENCES

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