

EFFECT OF ELBOW POSITION ON GRIP STRENGTH IN CHILDREN: VALIDITY AND RELIABILITY OF TKK 5101 AND DYNX DYNAMOMETERS

STEFAN KOLIMECHKOV, LUBOMIR PETROV & ALBENA ALEXANDROVA
NATIONAL SPORTS ACADEMY, SOFIA, BULGARIA



Introduction

One of the most widely used methods to assess upper-body isometric strength in children is the handgrip strength test. Owing to inconsistent findings, however, it is not clear which elbow position and which dynamometer type are most appropriate for achieving the maximal grip strength. Therefore, the purpose of this study was to investigate whether elbow position and the type of dynamometer affect the handgrip strength in children.

Method

A total of 60 children, 6 to 11 years old (30 boys and 30 girls), from London participated in this study, and an ethics approval form was obtained prior to the tests. Grip strength was measured by two different dynamometers: TKK digital hand dynamometer (TKK 5101 Grip-D, Takey, Japan) and DynX electronic hand dynamometer (MD System, Inc., OH, USA). Every child performed two different tests with each type of dynamometer. The first test was with the elbow fully extended, and the second with flexed elbow at 90° as shown in Fig. 1.

Table 1. Handgrip strength in children, n=60 (mean ± SD)

Dynamometer/Hand		Extended	Flexed	Sig
TKK	Right	14.58 ± 3.04	12.97 ± 2.99	p<0.001
	Left	14.25 ± 3.05	12.61 ± 2.99	p<0.001
DynX	Right	13.84 ± 3.22	13.35 ± 3.01	p<0.05
	Left	13.35 ± 2.95	12.77 ± 2.96	p<0.01

The validity and reliability of the TKK and DynX dynamometers were analysed using known weights by plotting the differences against their mean, according to the Bland & Altman approach (Fig.2). The criterion-related validity analyses showed a systematic bias of -0.20 kg (P<0.05) for the TKK, and -0.42 kg (P<0.001) for the DynX dynamometer. The reliability analyses revealed a systematic bias of -0.07 kg in the TKK, and 0.10 kg in the DynX dynamometer (P>0.05 for both).



Fig.1. Handgrip strength test with fully extended and flexed elbow, using TKK and DynX dynamometers

Results

While using the TKK dynamometer, grip strength was significantly higher when the test was performed with the elbow extended, in contrast to those obtained with flexed elbow (14.58±3.04 kg vs 12.97±2.99 kg, P<0.001 for the right hand, and 14.25±3.05 kg vs 12.61±2.99 kg, P<0.001 for the left). Furthermore, Cohen's effect size values (d=0.87 for the right hand, and d=0.91 for the left) suggested high practical significance. When using the DynX dynamometer, the difference between the two elbow positions was smaller (13.84±3.22 kg vs 13.35±3.01 kg, P=0.035 for right hand, and 13.35±2.95 kg vs 12.77±2.96 kg, P=0.003 for left), and the effect sizes were small to moderate (d=0.28 and d=0.41, resp.)

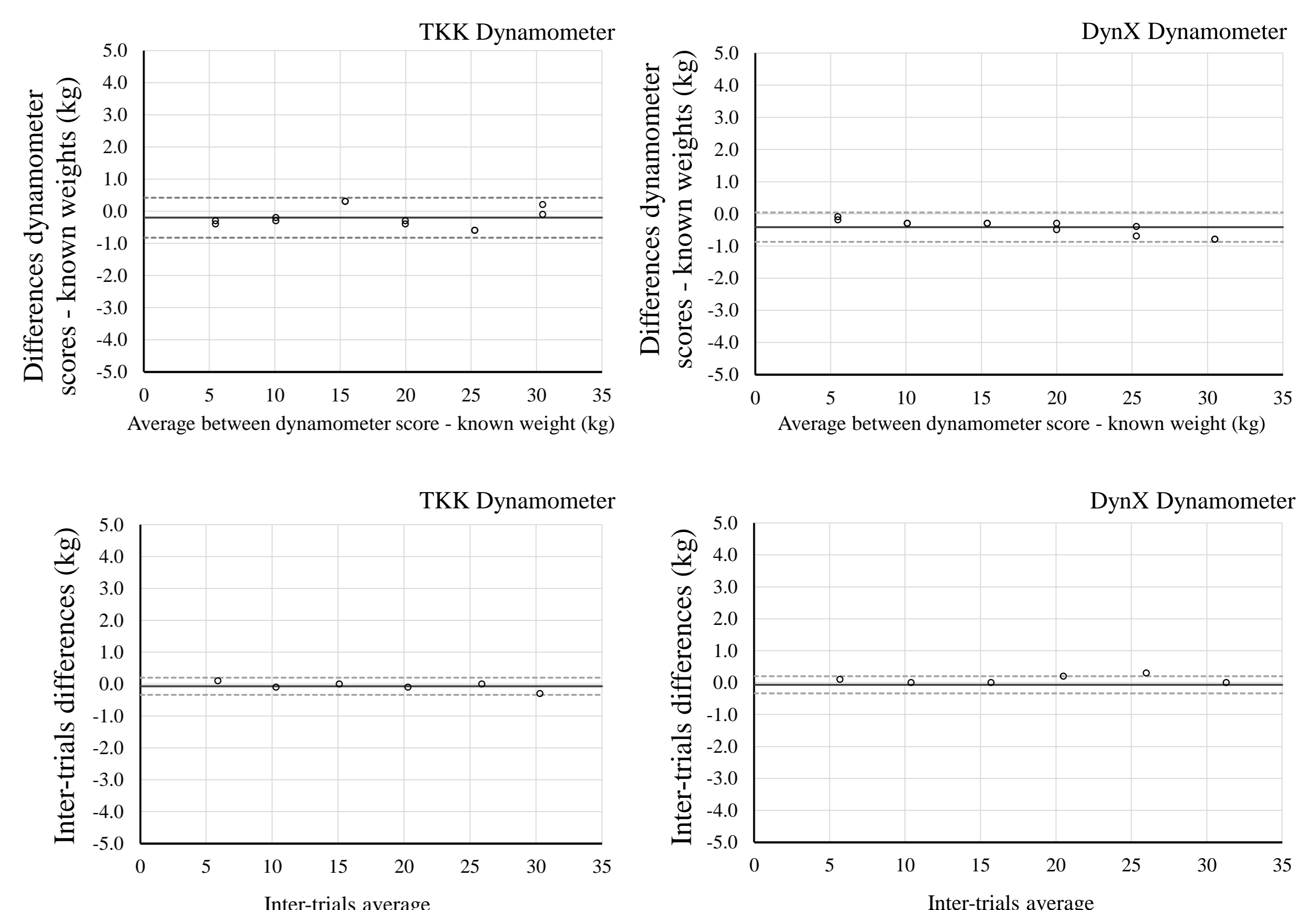


Fig.2. Validity and reliability of TKK and DynX dynamometers by Bland and Altman plots.

Summary and Conclusion

Both dynamometers provided sufficient results in terms of their validity and reliability, and can, therefore, be used when assessing handgrip strength in children. Performing the handgrip strength test with elbow extended appears to be the most appropriate protocol in order to evaluate maximal handgrip strength in children.