

Association between hand-held dynamometer measures of hamstring strength and force obtained from the Nordic hamstring exercise.

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Background: The Nordic hamstring exercise (NHE) is included in many injury prevention programmes. Recently, a device that measures force at both ankles during the NHE has been introduced to help monitor and track an athlete’s progress. Understanding the association between different hamstring strength protocols may reveal a better understanding of the NHE as an assessment and help practitioners to decide on its application.

Objective: To explore the associations between a series of hamstring strength measures obtained from a hand-held dynamometer with the force obtained during a NHE.

Method: Design: This cross-sectional study involved participants being measured during a single session. Associations between all individual measures were assessed. In addition, the combined effect of the hand-held measures to predict Nordic eccentric strength (NES) were explored.

Setting: Professional team sports. **Patients (or Participants):** Seventy-nine professional male team sport athletes. **Main Outcome Measurements:** NES obtained from a commercial device (Figure 1.0). Hand held dynamometry break assessments of hip extension (HE: Figure 2.0), hamstring inner range strength (HI: Figure 3.0) and hamstring strength at 30° knee flexion (H30: Figure 4.0).

NES Protocol



Figure 1.0 Nordic Eccentric Strength (NES) testing device

HHD Protocol



Figure 2.0 Hip extensors (including Gluteus Maximus)

Figure 3.0 Hamstring tested at inner range flexion

Figure 4.0 Hamstring tested at 30° flexion

Results: Descriptive statistics for all strength tests are provided in Table 1.0. Based on the univariate correlations between each strength test for preferred limb only (Table 2.0), the smallest association found was between NES and HE ($r^2=0.02$) and the largest association between NES and HI ($r^2=0.26$). Using multiple regression (Figure 5.0 and Equation 1), HI ($P=0.0001$) and H30 ($P=0.0083$) predicted NES ($r^2=0.32$; RMSE = 64N; $P<0.0001$). The model was not improved with the addition of HE ($r^2=0.33$; RMSE = 64N; $P<0.0001$). Decision tree induction (Figure 6.0) revealed that; of the HHD tests, inner hamstring strength contributed most followed by strength at 30° to predict NES. Those weakest at Nordics had a HI < 27.8 kg; those with the highest NES had both HI >27.8 kg and H30 >33 kg; and finally the intermediate group had HI >27.8 kg but were weaker at H30 (<33kg).

Table 1.0. Descriptive statistics (n=79)

Test	Mean (± SD)
Hip Extn	38.2 ± 4.1 kg
H30	32.7 ± 5.1 kg
HI	31.6 ± 5.5 kg
Nordic Eccentric Strength	393.2 ± 76.9 N

Table 2.0. Correlation matrix for hamstring strength tests

Test	Hip Extn	H30	HI	Nordbord
Hip Extn		-	-	-
H30	r = 0.25		-	-
HI	r = 0.32	r = 0.37		-
Nordic Eccentric Strength	r = 0.14	r = 0.42	r = 0.51	

Equation 1. $NES = 79.36 + 4.123 * H30 + 5.66 * HI$

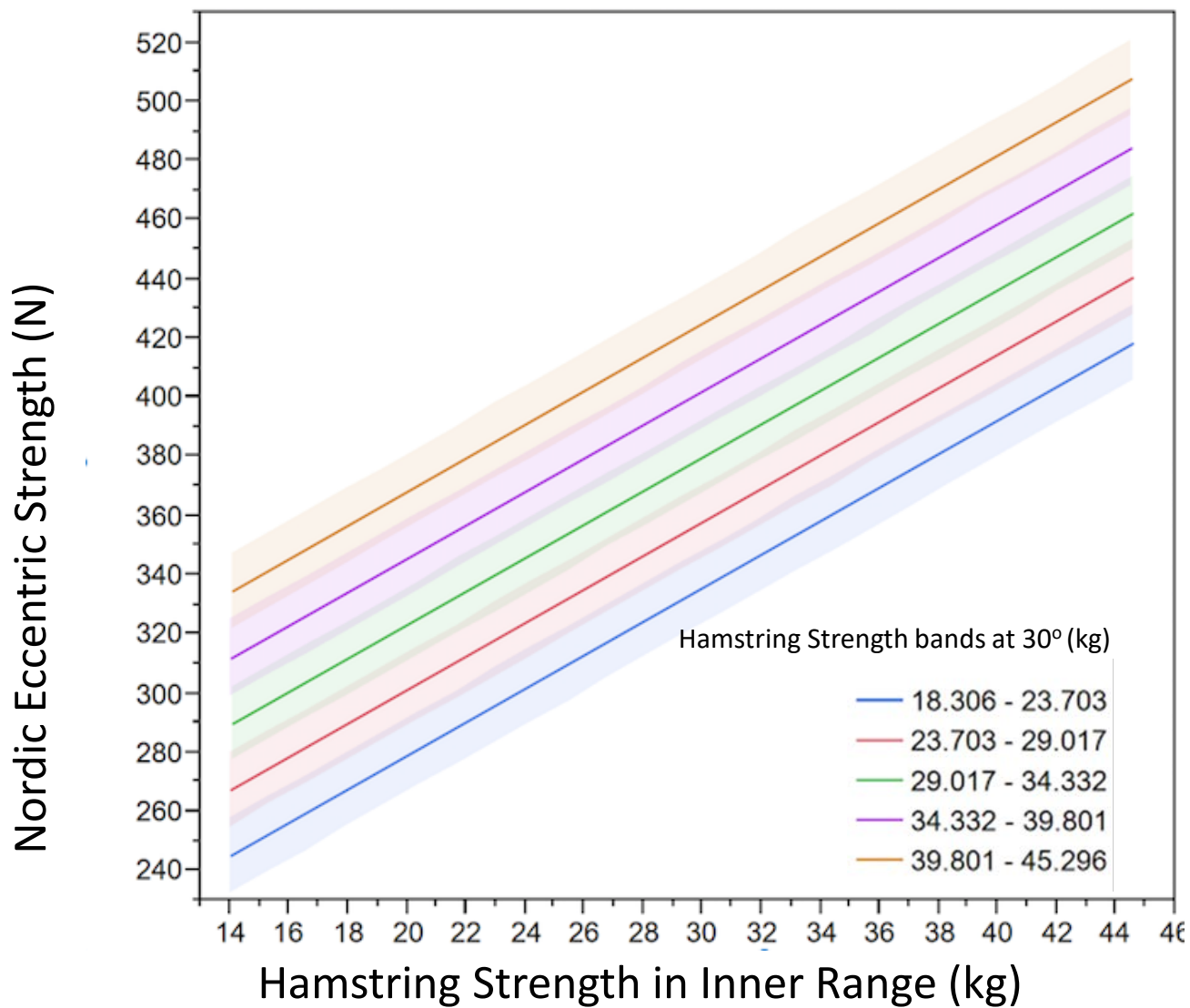


Figure 5.0 Association between HHD measures at inner range (kg) and 30° (kg) with Nordic Eccentric Strength

Conclusion: Each hamstring strength assessment may offer unique information about the current hamstring strength quality of an athlete. However for athletes who lack HI strength, a position that corresponds to the early phase of the Nordic Hamstring Exercise, it is likely they will have a constrained NES. Those who display higher HI strength (>27.8Kg) will then be differentiated by their H30 strength. This information may be useful for therapists looking for normative data on which to make screening comparisons. It can also be used to assist return to play decision making. Therapists who wish to estimate NES can apply equation 1 to their HHD scores. Finally, our findings indicate a potential relationship between HI and NES that may emphasize the need for hamstring strain injury rehabilitation to include HI strengthening in addition to using the NHE.

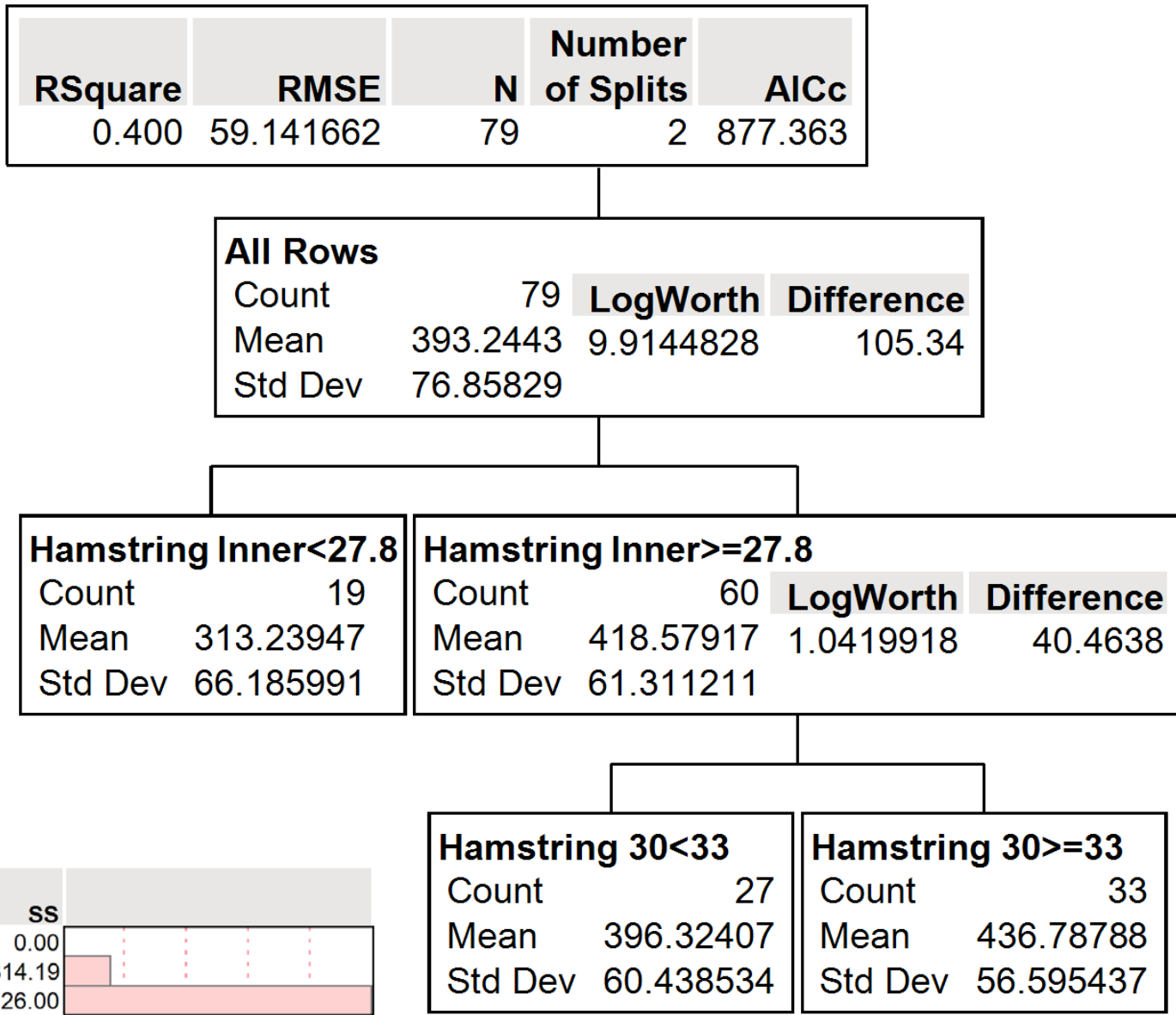


Figure 6.0 Final decision tree rules and column contributions



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