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The effect of body mass on the 30-15 Intermittent Fitness Test in Rugby Union players

Running head: 30-15$_{IFT}$ in Rugby Union

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Abstract

Purpose: To A) evaluate the difference in performance of the 30-15 Intermittent Fitness Test (30-15$_{IFT}$) across four squads in a professional rugby union club in the United Kingdom (UK), and B) consider body mass in the interpretation of the end velocity of the 30-15$_{IFT}$ (V_{IFT}). **Methods:** One hundred and fourteen rugby union players completed the 30-15$_{IFT}$ mid-season. **Results:** V_{IFT} demonstrated small and possibly lower (ES = -0.33; 4/29/67) values in the Under 16s ~~in comparison~~compared to the Under 21s, with further comparisons unclear. With body mass included as a covariate all differences were moderate to large, and very likely to almost certainly lower in the squads with lower body mass, with the exception of comparisons between Senior and Under 21 squads. **Conclusions:** The data demonstrate that there appears to be a ceiling to the V_{IFT} attained in rugby union players which does not increase ~~improve~~ from Under 16s to Senior level. However, the associated increases in body mass with increased playing level suggest that the ability to perform high intensity running is increased with age, although not translated into greater V_{IFT} due to the detrimental effect of body mass on change of direction. ~~demonstrate very likely – almost certain improvements in V_{IFT}.~~ Practitioners should be aware that V_{IFT} is unlikely to improve, however it needs to be monitored during periods where increases in body mass are evident.

Key words: High-intensity running, training, evaluation, adolescent.

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Introduction

Rugby union is a physically demanding intermittent contact sport, characterised by high-intensity efforts such as accelerations, sprinting, ball carrying, tackling, static exertions and collisions, followed by incomplete recovery.[1] High levels of contact during match-play favour players with increased body mass, [2] whilst momentum is considered an important physical quality for successful performance. [3] Therefore, the movement and physical demands of match-play require high levels of aerobic capacity, speed and optimal body composition. [4]

Physical testing of junior rugby union players has identified that high-intensity running ability, assessed via the 30-15 Intermittent Fitness Test (30-15_{IFT}) [5] and Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IRTL1) [6] does not increase~~mprove~~ with age. However, body mass and sprint momentum demonstrate~~d~~ moderate ~~(ES = -0.7)~~ to large (ES = -0.7 - -1.5) and moderate to very large (ES = -0.6 - -2.1) increases with age between Under 16s and Under 21s age categories,~~.~~ [7] and may be limiting factors due to an increased energetic cost of acceleration and deceleration during multiple changes of direction inherent with both tests. Increased ~~in~~ body mass was not considered in the analysis or interpretation of the 30-15_{IFT} data, [7] thus may not be a true representation of ~~actual changes in~~ high-intensity running ability. Both the 30-15_{IFT} and Yo-Yo IRTL1 have ~~a~~ similar sensitivity to training, [8] with the 30-15_{IFT} ~~appearing to~~ offering greater use to practitioners ~~as it can be used in~~ through the prescription of high-intensity training.

With this in mind, it seems appropriate that if the 30-15_{IFT} is to be used in rugby union populations, understanding the interaction of body mass upon the final velocity of the test (~~i.e., velocity at 30-15~~~~$_{IFT}$;~~ V_{IFT}), may assist practitioners to assess when players have practically improved their high-intensity running ability without an increase in V_{IFT}. Therefore, the purpose of the present study was to a) evaluate the differences in V_{IFT} across a professional rugby union club in the United Kingdom (UK), and b) consider body mass in the interpretation of V_{IFT}.

Methods

Participants. One hundred and fourteen rugby union players from a UK professional rugby union club and four squads; Senior (XV; n =24), Under 21s (U21; n =15), Under 18s (U18; n =27) and Under 16s (U16; n =48) participated in the study. Training frequency ranged from between 10-12 sessions/week

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in XV, and 2-6 sessions/week in U16 respectively;~~ and~~ includinging~~ed~~ resistance training, technical, tactical field sessions and conditioning across all squads. ~~All p~~Participants provided informed consent to participate in the study, which was approved by the ethics committee.~~ with informed parental consent (for players under 18 years) obtained.~~

Testing. The study was conducted during the mid-season period. All players were familiar with the test, which was conducted on artificial turf, following two days of complete rest and prior to any further training. The test consists of 30 second shuttle runs over 40 m, with 15 seconds of recovery. The speed of the test is controlled by an audible signal which beeped at appropriate intervals, whereby players were to be within a 3 m tolerance zone at either end or the middle of the 40 m shuttle. The start speed of the test ~~i~~was 8 km·hr^{-1} and~~ is~~ increased by 0.5 km·hr^{-1}at each successive ~~running~~ shuttle. Following successful completion of a level players were instructed to walk forwards to the nearest line at each extremity and middle of the shuttle at 20 m. The test ~~was~~ terminated when players were no longer able to maintain the imposed speed of the test or when they did not reach a 3 m tolerance zone on three consecutive occasions. The last completed stage was noted as V_{IFT} [5].

Statistical Analysis. All data are presented as means ± standard deviations (±SD) for each squad. Following log-transformation to reduce ~~any~~ bias~~error~~ arising from non-uniformity error, data were analysed for practical significance using magnitude based inferences. [9] Differences between squads were measured to assess if V_{IFT} was higher~~larger~~, similar or lower than the smallest ~~worthwhile~~ practical difference ~~change (SWC~~ (SPD(0.2 x ~~multiplied by the~~ between-subject ~~standard deviation~~SD))~~)~~ based on Cohen's *d* effect size principle. [10] ~~using~~ [9] ~~an excel spreadsheet.~~ [11] The probability that the magnitude of the difference ~~change~~ was greater than the SPD~~WC~~ was rated as~~<0.5 %; almost certainly not, 0.5-5 %; very unlikely,~~ 25-75 %, possibly, 75-95 %, likely, 95-99.5 %, very likely, >99.5 % almost certainly. ~~The magnitude of increase or decrease was described as substantial when the probability of the effect being equal to or greater than the SWC (ES≥0.2) was ≥75 %. Those that were~~ Differences less than the SPD~~WC~~ ~~(ES≤0.2) were~~ were described as trivial. Where the 90 % Confidence Interval (CI) crossed both the upper and lower boundaries of the S~~WC~~PD (ES±0.2), the magnitude of the difference~~change~~ was described as unclear. Covariate adjustment of body mass was applied in the following manner; linear trendlines were fitted to the plot of V_{IFT} and body mass in each group for pairwise comparison. The mean body mass of all participants in the pairwise comparison

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was then applied to the following equation to calculate the adjusted V_{IFT};

$$\text{Adjusted } V_{IFT} = slope \times x + intercept$$

With *slope* as the slope of the trendline, *x* as mean body mass of all participants in the pairwise comparison, and, *intercept*, where the trendline crossed the *y* axis; see Figure 1. Adjusted values were then compared to assess the effect body mass had upon The covariate of body mass was applied using an excel spreadsheet to adjust the ES, and assess the effect body mass had upon the differences in V_{IFT} for each comparison.[11]

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Results

Table 1 displays the participant characteristics and V_{IFT} for each playing squad. A possibly lower V_{IFT} (4/29/67) in the Under 16s in comparedison to the Under 21s (ES: -0.33) was the only difference demonstrated between squads; see and is shown in Figure 2 1.

With body mass included as a covariate, moderate to large decreased lower V_{IFT}, which was very likely (XV vs. U18, 0/4/96; U21 vs. U18, 0/3/97; U18 vs. U16, 0/1/99) and almost certainly greater than SPD (XV vs. U16, 0/0/100; U21 vs. U16, 0/0/100) were observed between squads, with the exception of the difference in V_{IFT} between XV the Senior squad and the Under 21s (37/45/18) which was unclear; see Figure 21.

Discussion

This is the first study to report reference V_{IFT} across a professional rugby union club including Senior and academy age group players. Our results show that absolute V_{IFT} remains relatively stable from U16 to XV level. This is an important finding as in that it demonstrates to practitioners that increases improvement in absolute V_{IFT} during academy developmental periods (U16 to U21) may be limited, and may in part be due to consistent moderate increases in body mass between consecutive age groups.[7] Further to this our results suggest that the stability in V_{IFT} demonstrate a *ceiling* value in rugby union specific cohorts.

While absolute V_{IFT} remained stable across all squads; our results clearly demonstrate that increases in body mass, whilst attaining the same absolute V_{IFT}, demonstrate a very likely – almost certainly higher improved relative V_{IFT}. Increases in body mass are also likely to impact upon momentum, which is considered important for successful performance,[3] therefore the interaction of V_{IFT} and body mass appears favourable for rugby union players.

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Practical applications

Differences in absolute V_{IFT} are limited in rugby union players across increasing age categories. However, the data suggest that the ability to perform high intensity running is increased with age, although not translated into greater V_{IFT} due to the detrimental effect of body mass on change of direction.~~ability to attain similar V_{IFT} whilst increasing body mass results in very likely – almost certain improvement in performance of the 30-15~~$_{IFT}$. During periods where body mass is increased, maintaining V_{IFT} likely reflects an improved tolerance to high-intensity running.

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Conclusion

The present results provide reference values for V_{IFT} in rugby union populations, and ~~further~~ demonstrate the necessity for practitioners to scrutinise their data beyond absolute values and understand the interaction of increased body mass upon measures of high-intensity running ability when an improvement is the desired outcome. Further research needs to address allometric scaling so that individuals with the same V_{IFT} but differing body mass can be ranked. This would also allow greater monitoring of changes in V_{IFT} at an individual level.

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Table 1. Participant characteristics and velocity attained from the 30-15 Intermittent Fitness Test (V_{IFT}) of Senior, Under 21, Under 18 and Under 16 Rugby Union players from a professional rugby club in the United Kingdom. Adjusted V_{IFT} for each pairwise comparison is also included demonstrating the effect body mass has between groups.

	Under 16s (n = 48)	Under 18s (n = 27)	Under 21s (n = 15)	Senior (n = 24)
Age	15.2 ± 2.3	17.2 ± 0.6	19.5 ± 1.1	26.5 ± 3.2
Height	177.2 ± 7.2	183.8 ± 7.1	186.7 ± 6.2	188.3 ± 6.5
Body Mass	76.2 ± 13.1	88.4 ± 10.8	99.7 ± 12.0	103.9 ± 14.5
V_{IFT} (km·hr^{-1})	18.9 ± 1.1	19.1 ± 1.1	19.2 + 1.0	18.9 ± 1.3
	Pairwise adjusted V_{IFT} (km·hr^{-1})			
Senior vs. Under 21s			19.1 ± 0.7	19.0 ± 0.9
Senior vs. Under 18s		18.7 ± 0.9		19.5 ± 0.9
Senior vs. Under 16s	18.5 ± 1.0			20.2 ± 0.9
Under 21s vs. Under 18s		18.9 ± 0.9	19.6 ± 0.7	
Under 21s vs. Under 16s	18.7 ± 1.0		20.2 ± 0.7	
Under 18s vs. Under 16s	18.7 ± 1.0	19.6 ± 0.9		

Data presented as mean (± SD)

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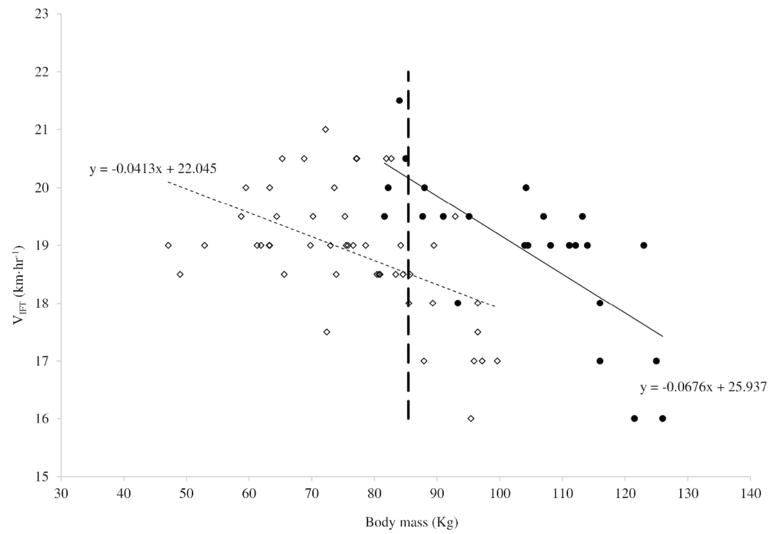

Covariate adjustment of body mass for two squads of rugby union players when comparing the 30-15 Intermittent Fitness Test (30-15IFT) end speed (VIFT). Black circles and open diamonds represent performance VIFT in comparison to body mass (kg) for the Senior and Under 16s squads respectively. The black (Senior) and dashed (Under 16s) trendlines represent the relationship between VIFT and body mass for each group. The vertical dashed line is the mean body mass of the Senior and Under 16s players combined and is used as the covariate, which is applied to the equations (see Methods) relating to each individual trendline to adjust VIFT.
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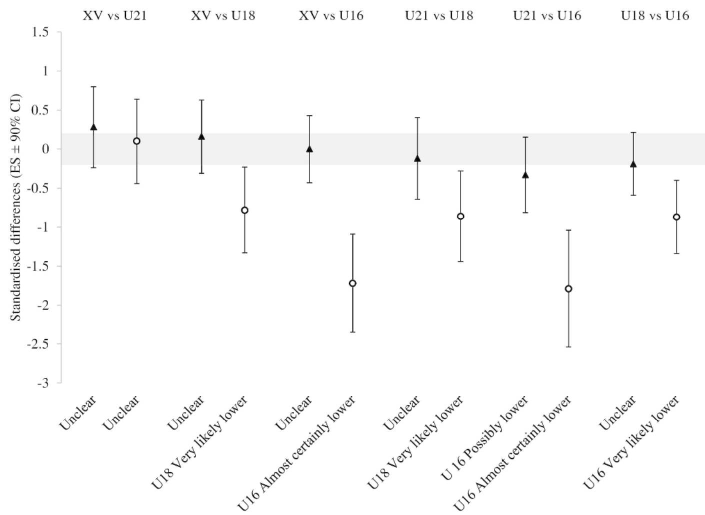

Comparisons in performance of the 30-15 Intermittent Fitness Test (30-15IFT) between squads of a professional Rugby Union club with and without body mass applied as a covariate, demonstrated as standardized effect size' (ES) ± 90% confidence intervals (CI). Magnitude based inferences are included to demonstrate the certainty in the differences between groups. The shaded area represents trivial differences (see Methods). Open circles represent differences in performance of the test with body mass accounted as a covariate, with black triangles representing differences without.
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