Assessment of performance in recreational and competitive climber

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ROCK CLIMBING AS A PECULIAR KIND OF MOUNTAIN LOCOMOTION

Rock climbing is a unique sporting activity in which the role of the upper limbs and the predominantly vertical motion distinguish it from all other land based movements.

Moreover, the vertical locomotion is associated with the need to reach a specific task.

Rock climbing has increased in popularity both, as recreational activity and as competitive sport.

QUESTIONS REGARDING CLIMBING AS RECREATIONAL OR COMPETITIVE SPORT

Recreational activity

The practice of rock climbing as recreational activity has raised questions if this kind of regular activity bestows the health benefits, including reduced risk of chronic diseases;

competitive sport

The increased popularity of climbing competitions has raised questions on the efficacy of proposed new training methods and, consequently, has stressed the need for specific measures to value the training progresses of the athletes.

ASSESS METABOLIC AND CARDIO-RESPIRATORY RECRUITMENT OF CLIMBING AS RECREATIONAL ACTIVITY

Cardio-respiratory and metabolic responses (Pulmonary ventilation –VE-, heart rate –HR-, oxygen intake –VO2-, carbon dioxide uptake -VCO2- and blood lactate –La-) to rock climbing, measured on expert and recreation climbers with portable metabolimeter and telemetric HR monitor, were used to assess metabolic and cardio-respiratory recruitment in order to establish if this kind of regular activity bestows the health and fitness recommendations.

ASSESSMENT OF INTENSITY OF RECREATIONAL ACTIVITY

The metabolic and cardio-respiratory intensity of the recreational climbing is well within (~80% of theoric HRmax and ~70% of VO2max) [Booth et al., (1999), Rodio et al., (2008)] the range recommended by the American College of Sports Medicine (ACSM) for health and fitness purposes when the climb is performed by subjects with good aerobic fitness and on relatively easy routes [Rodio et al., (2008)].

ASSESSMENT OF FREQUENCY AND DURATION OF RECREATIONAL ACTIVITY

But recreational climbers exercise at maximum1-2 times a week (typically in the week-end), thus based on frequency and duration of the exercise, recreational climbing seems not to fulfill the recent ACSM and American Heart Association (AHA) recommendations (at least 30 min of moderate activity 5 days per week or at least 20 min of vigorous aerobic activity, 3 day per week or a combination of the two [Haskell WL et al. (2007)] for health and physical fitness maintenance purposes.

ASSESSMENT OF INTENSITY OF WEEKLY ENERGY EXPENDITURE

Weekly leisure-Energy Expenditure (EE) assessment is an alternative approach to determine compliance with physical activity recommendations ***[Mudd LM, et al. (2008)]*****.**

ASSESSMENT OF INTENSITY OF WEEKLY ENERGY EXPENDITURE

The weekly leisure-EE of US adults complying with the conventional (ACSM and/or IOM - Institute of Medicine -) physical activity recommendations (based on wether individuals meet or exceed both duration -min$*$ d^{-1} - and frequency -d$*$wk^{-1} - requirements for leisure time activities) was measured.

ASSESSMENT OF INTENSITY OF WEEKLY ENERGY EXPENDITURE

A mean value of 27 and 21-43 kcal∗kg^{-1}∗ week was calculated to be the leisure-time EE for the subjects defined as ACSM and IOM active, respectively.

It was demonstrated that climbers of the same physical fitness but different ability level, have different EE when climb at comfortable speed for recreational purpose on the same graded route which is beneath climber's level.

In fact, recreational climbing costs about 1000 kcal∗week (i.e., 14 kcal∗ kg^{-1}∗ week) to expert climbers and 1500 kcal∗ week (i.e., 25 kcal∗kg^{-1}∗ week) to low expert climbers ***[Rodio et al., (2008)]****.*

ACCOMPLISHMENT WITH ACSM/IOM RECOMMENDATIONS - low level climbers -

Recreational climbing accomplish the conventional ACSM and IOM recommendations when it is performed on a route that is graded beneath the climber's technical ability. Thus, it is a useful practice to maintain health and fitness and to maintain a healthy weight, almost when consuming the typical US diet.

ACCOMPLISHMENT WITH ACSM/IOM RECOMMENDATIONS – high level climbers -

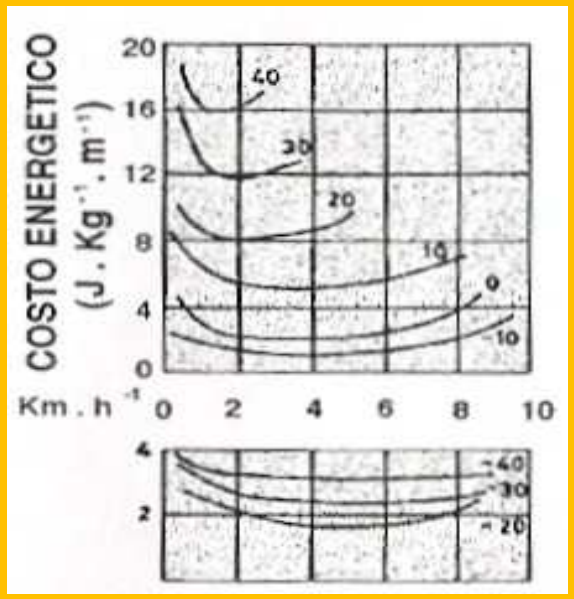
Recreational climbing do not accomplish the conventional ACSM and/or IOM recommendations for health and fitness and weight management when it is performed on a route whose grade is too much beneath climber's technical level. Thus, it seems not to be a useful practice to maintain health and fitness and to maintain a healthy weight in expert climbers when performed on a route that is graded too low.

IMPORTANCE OF ABILITY LEVEL

Expert and low level climbers have the same caloric expenditure (~ 70% VO2max) when they climb on the same relatively easy route but the speed is very different. Novice climbers spend in more time in the holding phase and the speed sensibly decreases. This is the explanation of the greater EE in these subjects (25 kcal∗kg^{-1}∗ week vs. 14 kcal∗kg^{-1}∗ week). Expert climbers should thus increase difficulty; nevertheless, increasing difficulty does not increase [Watts and Drobish (1988)] or lower [Billat et al. (1993)] the VO_2 (Probably due to the fact that specific VO_{2peak} was attianed) and increases HR and La [Watts and Drobish (1988)] and reduces force, the best way to accomplish the ACSM/IOM purposes for expert climbers is to increase the vertical displacement.

ENERGY COST OF RECREATIONAL CLIMBING

Thus, a more appropriate method to quantify the economy of climbing is the assessment of its energy cost (EC) i.e., the net (or gross) energy spent to cover a unit distance of that route. In this way it would be possible for the climber to provide the appropriate displacement in order to accomplish the ACSM recommendations in terms of weekly EE.



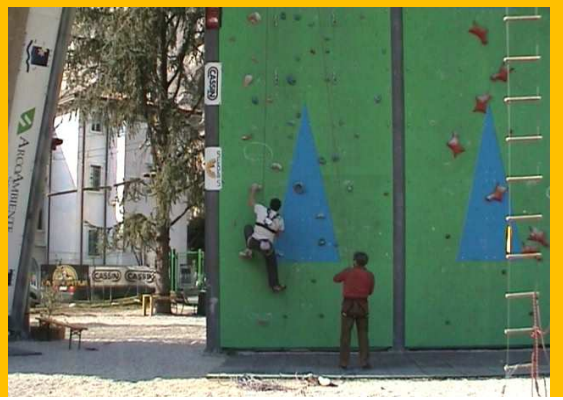
(da Margaria et al. 1938)

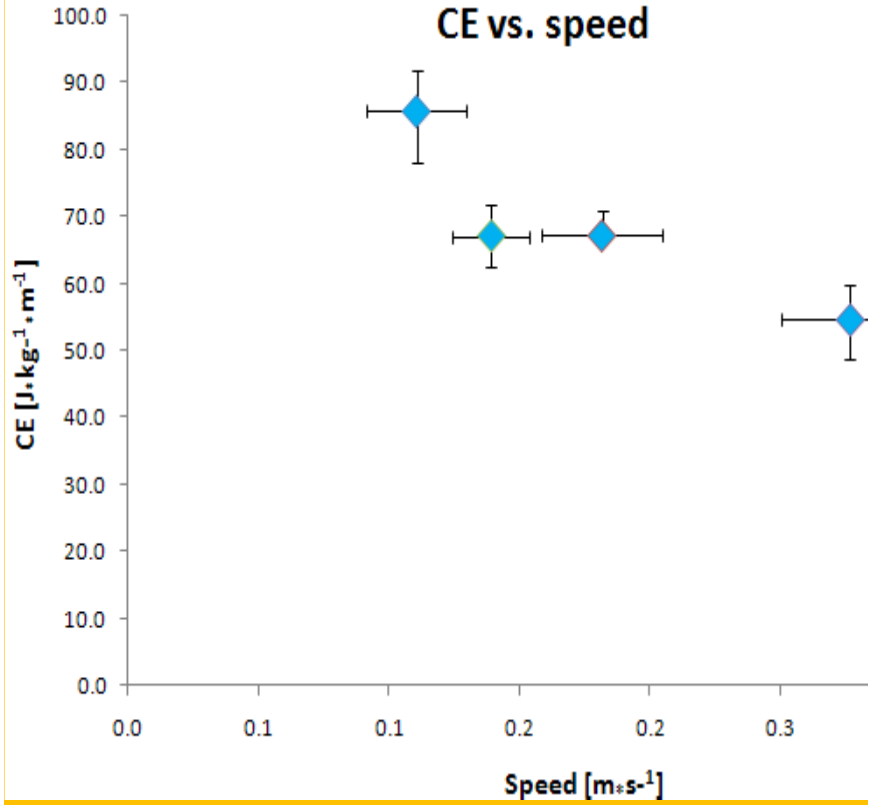
$$EC\ [J \cdot kg^{-1} \cdot m^{-1}] = \frac{V'O_{2\ net}\ [ml \cdot min^{-1} \cdot kg^{-1}]}{speed\ [m \cdot min^{-1}]}$$

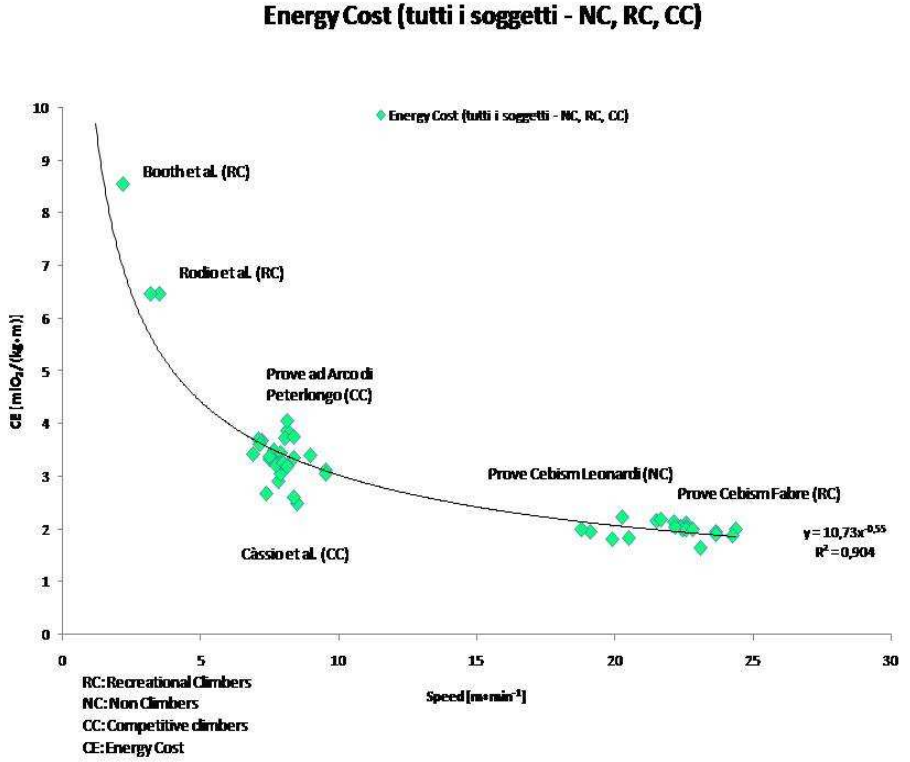
*i.e.,1000 kcal (14 kcal * kg-1 * week) are referred to ~750 m of vertical displacement in a week* ***[Rodio et al., (2008)]****. Expert climbers must double this displacement to accomplish the purpose of health and physical fitness.*

CLIMBING SPEED AFFECTS ENERGY COST

Climbing speed affects the EC, but we observed that recreational climbing on a relatively easy route is performed at same speed by expert climbers (~ 0,2 m∗s^{-1}).







A POSSIBLE NEW METHOD TO CLASSIFY CLIMBING ROUTES FOR RECREATIONAL PURPOSE

1) Choose a climbing route in the field of novice capability

2) Measure the self selected speed of Novice Intermediate and Advanced climber on that route.

3) Provide the specific EC for each ability level

In this way it would be possible for every climber (almost from Novice to Advanced) to compute the necessary displacement to reach for accomplishing the ACSM/IOM reccomendations.

French system		Standard numerical scale	Category
5	+	0,25	NOVICE
	b	0,50	
	c	0,75	INTERMEDIATE
6	a	1,00	
	a+	1,25	
	b	1,50	
	b+	1,75	ADVANCED
	c	2,00	
	c+	2,25	
7	a	2,50	
	a+	2,75	
	b	3,00	
	b+	3,25	
	c	3,50	
	c+	3,75	
8	a	4,00	ELITE
	a+	4,25	
	b	4,50	
	b+	4,75	
	c	5,00	
	c+	5,25	
9	a	5,50	
	a+	5,75	
	b	6,00	

IMPORTANCE OF PERFORMANCE ASSESSMENT

French system		Standard numerical scale	Category
5	+	0,25	NOVICE
	b	0,50	
	c	0,75	INTERMEDIATE
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	b	6,00	

A SPECIFIC TESTING TOOL TO ASSESS PERFORMANCE FOR CLIMBERS

Brent et al. (2009)[8] proposed a specific test (ROCT) based on the "rock-over" movement and demonstrated its validity as a measure of performance for rock climbing;

the same authors recognized that the ROCT is not sufficient to completely explain the variance in the technical ability of the climbers because it is a climbing-specific measure only of strength and flexibility,

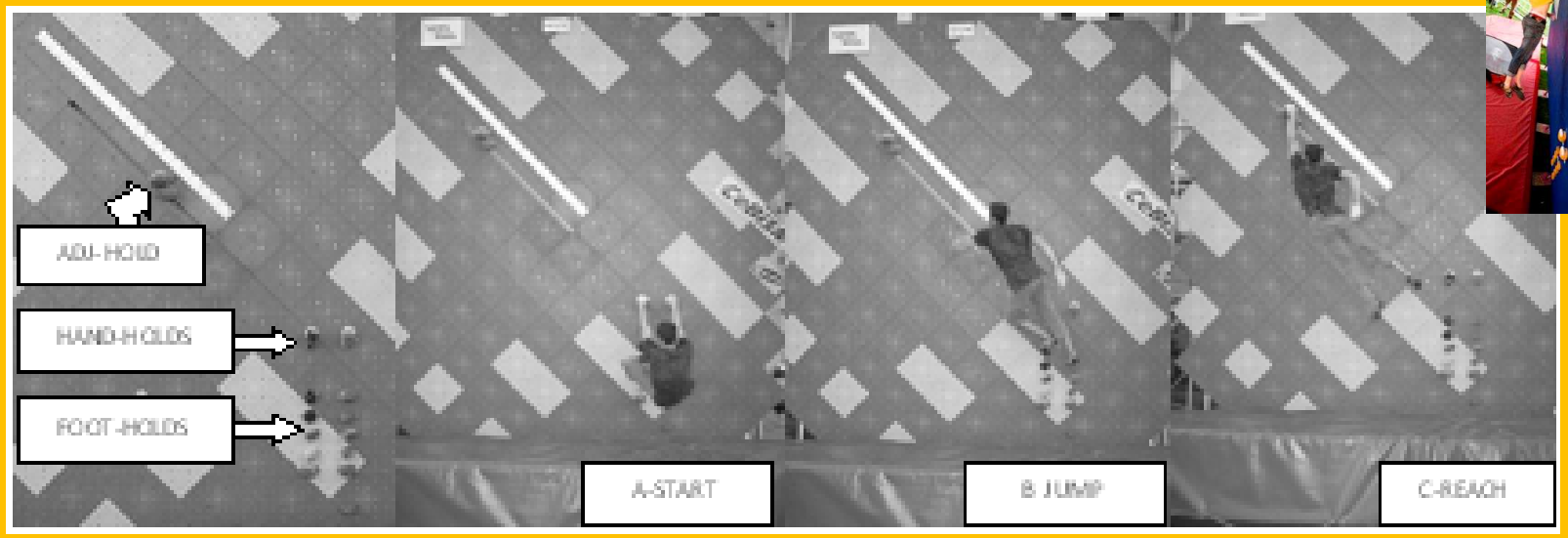
therefore, the same authors indicated the need to develop a series of climbing-specific tests capable to represent other specific features (as power and endurance), whose importance in rock climbing was widely recognized, we thus developed …

… a specific test battery for performance assessment in sport climbing

THE DYNO

COMPETITIVE CLIMBER
Dyno

The importance of the DYNO is exhibited by the fact that a) it is one of the subjects of sport climbing courses; b) challenges are sometimes organized as a side-event of boulder official competitions and c) even standard Guinness Book of Records rules for DYNO were established and a World Guinness Record now exists.



From that position, the climber has to jump for reaching an adjustable handhold placed in a 45 degrees position with respect to the vertical axis of the climber's body.

THE ENDURANCE

the test consisted of reaching the highest couple of parallel holds over a 10m overhanging (10 degrees) artificial climbing wall

THE SPEED

Climbers were requested to complete the 10m route while climbing as fast as possible, but avoiding "launches" i.e., reaching the maximum "fluidity" while climbing fast.

THE ABILITY LEVEL ASSESSMENT

French system		Standard numerical scale	Category
5	+	0,25	NOVICE
	b	0,50	
	c	0,75	INTERMEDIATE
6	a	1,00	
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	b	1,50	
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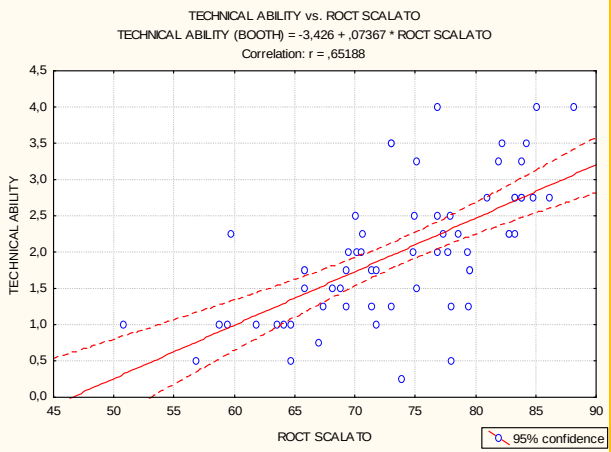
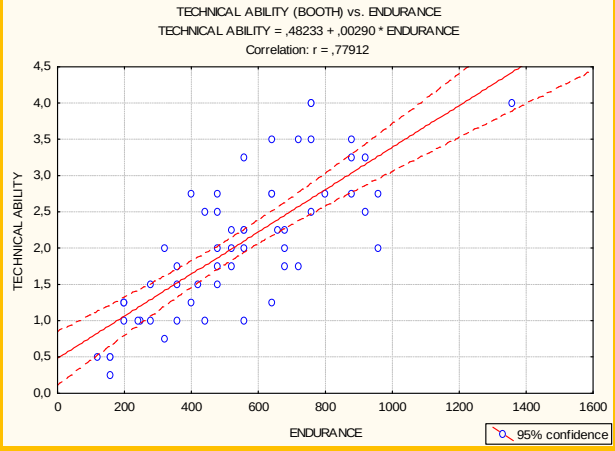
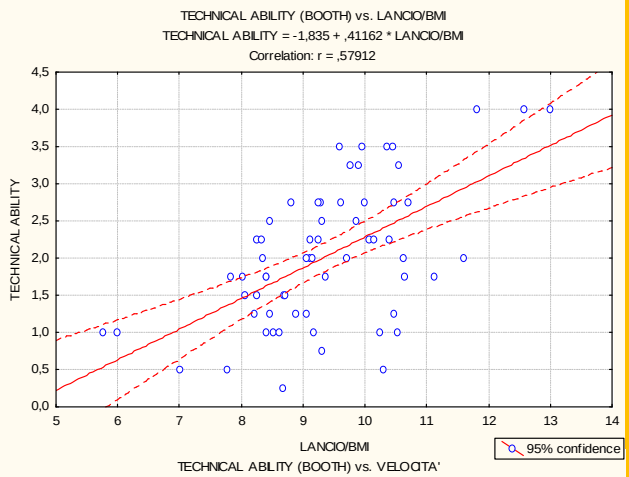
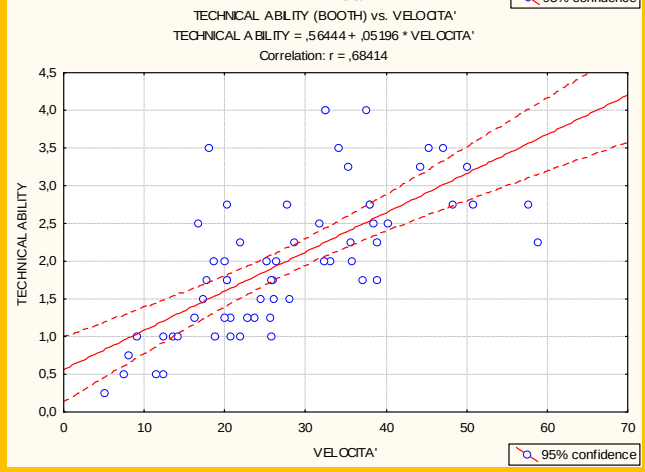
	a+	5,75	
	b	6,00	

RESULTS









Backward Multiple Regression Analysis

Dependent variable	*r*	*Adj. R^2*	*p*	*determinant*	*correlation indices (beta)*
Ability level	*0,86*	*0,72*	*0,001*	*END*	*0,428*
				SPEED	*0,246*
				ROCT	*0,237*
				DYNOs	*0,135*

RESULTS

		N	I	A	E
ROCT	mean	68,4 [b,c]	67,3 [b,c]	77,7	83,5
	sd	9,4	6,6	6,0	5,8
$DYNO_{BMI}$	mean	8,5 [b,c]	8,8 [b,c]	9,6 [c]	12,5
	sd	1,4	1,1	0,9	0,6
SPEED	mean	9,1 [a,b,c]	19,4 [b,c]	35,4	34,1
	sd	3,5	5,9	10,3	2,9
END	mean	150 [a,b,c]	331,2 [b,c]	653,1 [c]	960,0
	sd	20,0	136,2	179,0	346,0

CONCLUSIONS

We thus suggest to use the complete test battery in order to discriminate between novice, intermediate, advanced and elite climbers and to use the DYNO for performance assessment in competitive elite climbers.